Chapter 42
Disease Control, Public Health and Food Safety: Food Policy Lessons from Sub-Saharan Africa

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Abstract This chapter reviews the agro-economic environment in Sub-Saharan Africa as it relates to animal production, public health, and disease control to contextualize the concept of risk and food safety. Drawing mostly from the experience of Zambia, it analyzes food safety actors and interests in Sub-Saharan Africa, and provides an outline of the general regulatory framework that is in place on the continent, to explain how food safety governance is impacted by different interest groups and agendas. Two case studies are provided, zoonotic tuberculosis and avian influenza. The chapter demonstrates how the two zoonoses, both important food safety concerns, have been prioritized differently in the case of Zambia, as a result of multiple socio-political and economic factors. The chapter concludes that, in order to be useful, a definition of food safety risks should include multiple contextual issues and stakeholders along the food supply chain. It is important to keep in mind what national food safety governance actors perceive the risks to be, and how their definitions fit into the broader picture of food safety in general. Food safety governance regulatory processes should take into consideration local realities, local food supply chains and local food safety threats to ensure the appropriateness and sustainability of any and all disease control measures instituted. Context will always matter, and therefore, local ecological, biological and policy considerations should be given primacy.

42.1 A Risk Management Approach to Examining Food Safety, Disease Control and Public Health

Taking an African perspective on food law and food safety, this chapter tackles the concept of risk as it relates to food derived from animals. To bring the various issues that impact risk and food safety in Sub-Saharan Africa into focus and highlight the pertinent concerns for disease control, it is necessary to provide both a descriptive

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and an explanatory analysis of the issues surrounding food safety on the continent. This chapter's explanations are rooted in the analysis of the narratives of food safety actors and interests, and includes some detail on the general regulatory framework that is in place in the region, how it is influenced by different interest groups and agendas, and the politics of the policy process. These provide important lenses for understanding food policy in Africa. In order to deepen this discussion, some of the perceptions of risk and policy issues concerning the African agroecosystem in general are also highlighted. This chapter does not purport to provide a complete analysis. It merely provides contextual depth to case studies from a perspective of animal disease control, public health and food safety to illustrate important food policy lessons for the African region.

Food-borne diseases remain a significant problem for public health around the world. An estimated 70 % of diarrheal incidents across the globe are due to biological or chemical contamination of food.[1] The burden of food-borne illness is borne by both developed and developing countries. However, the literature suggests that the incidence is highest in the African region.[2] Over the last 15 years, according to the World Health Organization Regional Office for Africa (WHO-AFRO), the African region has suffered several major food-borne disease outbreaks, including aflatoxicosis in Kenya, anthrax in Zimbabwe, bromide poisoning in Angola and chemical intoxication in Nigeria.[3] WHO-AFRO suggests that the vast majority of food-borne incidents in the African region are unreported. Therefore, the true extent of this public health problem is unknown.

In Africa, an appropriate establishment and consistent maintenance of adequate food safety infrastructure would go a long way in reducing the burden of the public health threat of food-borne illnesses. But multipartite food supply chains make food safety a complex policy issue to unpack, particularly in the era of globalization. Therefore, the evolving issues around food safety and the complexity of global food supply chains[4] require the development of context-appropriate food safety and disease control structures and policies that appropriately mitigate the myriad threats to public health presented by food and food trade. This is because, the various stakeholders along the food chain—producers, retailers, consumers and regulators—all play a role in assuring that food is safe, sound and wholesome.

Food of animal origin carries multiple risks. In the case of food-borne illnesses, these risks can generally be grouped under intoxications or infections. The livestock production related threats to public health include acaricides used for tick control, antibiotic residues in meat and milk, infectious diseases, and pollutants from

[1]Buzby and Roberts (2009), pp. 1851–1862.

[2]Dewaal et al. (2010), pp. 483–490; WHO-AFRO (2012).

[3]*ibid*.

[4]see Kimball (2006).

agricultural runoff. Other important public health threats are zoonotic diseases. Rudolf Virchow, the pioneer of the concept of One Health,[5] first coined the term zoonosis in 1855.[6] Originally, zoonoses were defined according to the direction of disease transmission. Additional important terminology included zooanthroponosis, infections humans could acquire from animals, and anthropozoonosis, diseases that humans could transmit to animals.[7] This conceptualization of zoonoses, however, failed because the two terms were used indiscriminately, leading to an expert committee decision to abandon them. Instead, the committee recommended that the term zoonoses should be defined holistically as diseases and infections naturally transmitted between vertebrate animals and humans.[8]

Animal health is only one link in a long food production chain that contributes to the final quality of food. The promotion of animal health is vital to the enhancement of the quality and quantity of products derived from this source. This is especially true for food supply chains with global dimensions. Chemical and biological contamination can occur at any point from production to consumption. Through their associated impacts within the food production chain, animal breeding, feed, fertilizer and pesticide use, producers, processors, and retailers all add to or subtract value from the final product.

Globalization, economic development, expansion and diversification of agricultural food trade form causal links that increase public health risks, food safety hazards, and the spread of diseases.[9] Globalization transcends the nation state,[10] and brings with it social phenomena such as power and politics. Furthermore, in most low-income countries in the African region, economic considerations[11] are given primacy over health concerns.[12] This is reinforced in global context, where trade considerations run ahead of the implementation of measures that protect health.[13] Additionally, due to the process of globalization, policy-makers have seen a decline in their ability to control the determinants of health. Power relationships in many low-income countries are complicated by external relationships with advisors, experts, aid donors and financial institutions and internal institutional

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[5]The American Veterinary Medical Association has defined One Health as "the collaborative effort of multiple disciplines — working locally, nationally, and globally — to attain optimal health for people, animals and the environment." American Veterinary Medical Association, One Health (2008), available at https://www.avma.org/KB/Resources/Reports/Documents/onehealth_final.pdf (last accessed Jan 2015).

[6]Kahn et al. (2007), pp. 5–19.

[7]Krauss et al. (2003).

[8]Hubálek (2003), pp. 403–404; Mwacalimba (2013).

[9]Slingenbergh (2004).

[10]Lee et al. (2002).

[11]Walt and Gilson (1994), pp. 353–370.

[12]Lee and Koivusalo (2005), p. e8.

[13]*ibid.*

relationships characterized by large power gaps between actors,[14] with power and politics playing a role in shaping the process.[15]

This chapter examines zoonoses through multiple and layered lenses, the first of which is the concept of "the human-animal interface,"[16] with the goal of better capturing the broad socio-economic and political landscape of food safety. The understanding of the human-animal interface, as it relates to infectious disease governance, is important from two standpoints: First, the human-animal interface facilitates the examination of the relevant public health risks related to animals and their products in different contexts. Second, through food governance, and its relationship to risk enabling policy activities, the human-animal interface further adds to the understanding of the complexities associated with risk management. The corresponding risk enabling activities include the governance of land use, wildlife use and livestock production and chosen routes for economic growth and trade promotion. These activities both foster and enhance disease transmission.[17] Specific examples are provided through case studies of two zoonoses, one of which is a neglected disease, bovine tuberculosis (BTB), and the other an emerging disease, highly pathogenic avian influenza (HPAI, a.k.a. bird flu).

42.1.1 Overview of the Epidemiological Framework for Disease Control and Public Health in Food Safety

Epidemiology is defined as the study of the distribution and determinants of disease in defined populations. Disease determinants include risk factors for emergence which are both multifactorial and highly contextual. While epidemiology studies the dynamics of disease in defined populations, it also seeks solutions to disease problems to mitigate their impact on individual and public health. This chapter focuses on food safety within a disease prevention framework.

In a disease prevention framework, three levels of prevention are important: primary, secondary and tertiary prevention.[18] In primary prevention, the focus lies on averting incidents of disease in the first place. Secondary prevention strives to avert clinical manifestation of the disease state. Tertiary prevention tries to avert the complications of a disease state, such as extended morbidy, secondary infection or death.[19] These levels are also dependent on access to interventions, i.e. health system or government capacity and response, and do not factor in the role that industry, for instance, plays in disease prevention.

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[14]Walt and Gilson (1994).

[15]Navarro (1998) pp. 742–743.

[16]Greger (2007), pp. 243–299.

[17]Kimball (2006); Greger (2007).

[18]Kimball (2006).

[19]*Id.*, pp. 13−14.

The three levels of prevention are, of course, permeated by food safety governance, which reinforces the importance of this discussion within this book. For instance, primary prevention in food safety would involve the removal of chemical, physical or biological hazards from food before it is consumed. This includes the establishment of herd health programs for food animals, provision of safe feed, monitoring antibiotic use in animals, physical control mechanisms such as abattoir inspections and milk pasteurization, and the development and enforcement of food safety standards. Secondary prevention may include mechanisms for early health system response to food-borne disease outbreaks, institutional capacity to conduct timely food-borne illness outbreak investigations, food product recalls, destruction of contaminated produce or quarantine of implicated markets, farms, or animals to contain outbreaks. Tertiary prevention includes the appropriate treatment of food-borne illnesses, such as administering the correct medication to treat zoonotic tuberculosis. This prevention framework does not easily accommodate the roles that multiple stakeholders play in disease prevention, particularly those stakeholders that lie outside traditional food safety and health systems, but still impact the social determinants of health.[20] Logically, this begs the question; how can multiple stakeholder interests and influences be incorporated in this basic prevention framework?

One way of looking at disease prevention and management is to utilize a risk-based epidemiological model. In the epidemiological framework for disease control and public health in food safety, a risk based framework considers multiple risk factors along the food supply chain, from farm to fork, and the holistic impact of stakeholders on food safety and food-borne disease management. However, the concept of risk and its understanding is highly contextual, as our case studies will demonstrate. Risk is socially constructed. Therefore, risk identification and assessment are both innately human and dependent upon social activities that generate meaning. In other words, risk perception is contingent upon a shared understanding of reality.[21]

Risk is also "politicized" through several social processes, which separate risk from the actual dangers presented by various hazards.[22] But, the use of scientific information to inform policy is difficult. Paradoxically, one of the reasons for the difficulty to use science to inform policy on risk is scientific limitation to only the objective assessments of risk.[23] As Stirling and Scoones[24] contend in their 2009 paper on risk assessment and knowledge mapping, scientific assessments of risk often attempt to aggregate complex social and biological phenomena into a set of probabilities and outcomes, thereby often structuring the phenomena to become

[20]The social determinants of human health are the conditions of the environment where people live and work (Exworthy 2008).

[21]Horlick-Jones (1998), pp. 64–67.

[22]Douglas and Wildavsky (1982).

[23]Mwacalimba (2012), pp. 391–405.

[24]Stirling and Scoones (2009).

policy, rather than inform it. This also applies to risk assessment as applied in food safety and food policy.

Food-borne disease risks and their implications for holistic management require a multi-sectoral or shared understanding of Africa's food safety problems with a goal of a pragmatic development of solutions. Conceptually, the integration of the socio-political structures of disease risk and risk management should provide a useful framework for understanding food safety, disease prevention and public health in the African region. In other words, to be useful, an epidemiological framework for disease control and public health in food safety needs to be inclusive and open to multiple perspectives of African food safety problems. In order to succeed, it is important to properly frame food safety problems, and identify the different stakeholders involved along the food chain. Additionally, it is crucial to recognize the various stakeholders' roles and capacity for risk facilitation or management, as influenced by their institutional norms, priorities and ideas. The goal is to develop a consensual view of risk. In reality, however, the various stakeholders force aggregates of complex social and biological phenomena into risk metrics to which food governance systems are expected to somehow respond.

To create a usable disease control, response coordination and risk management framework, a proper understanding of both institutional power and the food policy framework are critical. Using this simplified risk-based epidemiological model, this chapter explains the various issues affecting food-borne diseases, their impact on public health and the policy implications of food safety governance. Fragmentation unfortunately is the complicated reality of many legal and policy issues at local, national and international levels. In applying this framework to the African region's multi-sectoral context, the boundaries between sectoral or "silo" responses to food safety will blur. Nonetheless, it should be clear by the end of the chapter that a one-cap-fits-all solution to food safety problems in the African region is unlikely effective.

42.1.2 Food Policy Regulatory Framework: Actors, Interests and Conflicts

The African continent's position on the development continuum puts it in the precarious state of having to deal with a double burden of disease,[25] i.e. both chronic, or diseases of affluence and infectious diseases.[26] Within this spectrum of disease threats, are food-borne illnesses. In turn, food-borne diseases remain a

[25]A double burden of disease is a state in which the prevalence of risk factors for chronic diseases (diabetes, heart diseases and cancers) increase at the same time that traditional health problems such as maternal and child deaths caused by infectious diseases are still major public health threats for the majority of the population.

[26]Green (1999).

significant problem for the region, given its high levels of poverty and urgent nutritional needs for its most vulnerable citizens. As highlighted in the introductory section, food-borne diseases are frequently reported in Africa, with high incidence. Most cases of food-borne diseases remain unreported. There are several factors responsible for this. In many countries in the region, there is the existence of poor food safety surveillance systems and weak obligatory reporting mechanisms for food-borne disease outbreaks, outside high profile diseases such as cholera. Reporting is also inaccurate in some cases, with only a handful of countries reporting incidence of food-borne illnesses. These knowledge gaps mean that an accurate picture of incidence is nonexistent, which limits our understanding of the public health impact of food-borne diseases in the region.

There are multiple stakeholders in food safety governance in the African region. These include both national and international actors. From the multilateral trade environment, characterized by overlapping regional trading blocs at continent level to professional rivalries at national and local levels, the food safety governance environment is fairly complex. Furthermore, the continent's myriad problems, make prioritizing food safety difficult. For instance, the WHO asserted that food-borne diseases and food safety do not feature very highly on national agendas although both have a major public health impact throughout the region. This assertion is based on a weighting of the paucity of resources directed at the issue. In fact, it is the political impetus to focus on food-borne diseases in the African region that is often absent.[27]

Fundamentally, the management of public and environmental health risks in the African region is characterized by fragmentation and the existence of conflicting national food safety standards.[28] The mandate to assure the safety of food of animal origin falls under various agencies, which can result in professional rivalries that impact negatively on food safety governance.[29] These mandates, enshrined in law and legal documents such as statutory instruments,[30] compound the problem of the policy disconnectedness surrounding food safety in Africa (see Table 42.1).

Understanding the role that external influences play in the policy processes for food safety and management in the African region is equally important. In many developing country settings, policy actors are forced to balance the external desires of funding agencies and international bodies as well as contend with internal power struggles.[31] Therefore, a hindrance to the management of risk in food safety in the African region is its dependence on development partners. External partners play a key role in defining national development agendas, by focusing their support on water delivery, primary healthcare, or particular infectious diseases such as tuberculosis, HIV and malaria. The dependence on development partners and the politics

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[27] WHO-AFRO 2012.

[28] Wilson and Otsuki (2001).

[29] Muma et al. (2014).

[30] Statutory Instruments are a means of creating delegated or secondary legislation.

[31] Walt and Gilson (1994).

Table 42.1 African regional and subregional economic partnerships

<table>
<tr><td>Algeria Morocco Libya Tunisia Mauritania</td><td colspan="2">AMU
Arab Maghreb Union</td></tr>
<tr><td colspan="2">Ghana Nigeria Cape Verde Gambia</td><td rowspan="3">ECOWAS
Economic Community Of West African States</td></tr>
<tr><td>Benin Togo Niger Mali Côte d'Ivoire Burkina Faso</td><td>WAEMU
West African Economic and Monetary Union</td></tr>
<tr><td>Senegal Guinea-Bissau
Liberia Guinea Sierra Leone</td><td>MRU
Mano River Union</td></tr>
<tr><td>Chad Cameroon Central African Rep. Gabon Equat. Guinea Rep. Congo</td><td>CEMAC
Communauté Économique et Monétaire de l'Afrique Centrale (Central African Economic and Monetary Community)</td><td rowspan="3">ECCAS
Economic Community of Central African States</td></tr>
<tr><td>Rep. Congo
Burundi Rwanda</td><td>ECGLC/CEPGL
The Economic Community of the Great Lakes Countries/ Communauté Économique des Pays des Grand Lacs</td></tr>
<tr><td colspan="2">Angola</td></tr>
<tr><td>South Africa Botswana Lesotho Namibia Swaziland</td><td>SACU
Southern African Customs Union</td><td rowspan="2">SADC
Southern African Development Community</td></tr>
<tr><td colspan="2">Angola Malawi Zambia Zimbabwe Mauritius Seychelles Mozambique</td></tr>
<tr><td>Somalia Ethiopia Eritrea Sudan Kenya Uganda</td><td>IGAD
Inter-Governmental Authority on Development</td><td rowspan="2">COMESA
Common Market for Eastern & Southern Africa</td></tr>
<tr><td colspan="2">Angola Egypt Burundi Rwanda
Comoros Madagascar
Malawi Zambia Zimbabwe Mauritius Seychelles</td></tr>
<tr><td>Burkina Faso Chad Libya Mali Niger Sudan Central African Republic Eritrea Djibouti Gambia Senegal Egypt Morocco Nigeria Somalia Tunisia Benin Togo Ivory Coast Guinea-Bissau Liberia Ghana Sierra Leone
Comoros Guinea Kenya São Tomé and Príncipe
Equatorial Guinea</td><td colspan="2">CEN-SAD
The Community of Sahel-Saharan States</td></tr>
<tr><td>Egypt Sudan Ethiopia Uganda Kenya Tanzania Burundi Rwanda the Rep. Congo Eritrea</td><td colspan="2">NBI
Nile Basin Initiative</td></tr>
<tr><td>Tanzania Kenya Uganda</td><td colspan="2">EAC
East African Community</td></tr>
</table>

The table shows the overlap of international economic partnerships and trading blocs in Africa. This multilateral trade environment, with its various agreements, provisos and foci, is an amorphous set of issues that, while not immediately obvious, have implications for disease spread and control. Typically, in such an environment, trade issues take primacy over health concerns, with profound implications for public health. The left hand side of the table lists the countries and the right shows the acronyms of economic partnerships they belong to (bold and italic terms) of aid has implications for the capacity of African countries to control the focus of funding.[32] The assistance provided by donors towards food safety may not foster ownership among local stakeholders, given that the focus is donor driven and not aligned with existing needs and local realities.[33] In addition, the WHO states that development partners are not always willing to commit to sustaining the strengthening of food safety management systems.

42.1.3 Key Stakeholders and Mandates for Risk Management and Food Safety in Africa

There are contextual differences in food control system implementation across the African continent. In general, however, the existing food safety and control systems do not provide the policy coherence necessary for stakeholder agencies to synergistically prevent food safety problems. International guidelines such as the *Codex Alimentarius*[34] do not have the supporting legislative framework in many African countries. Many of the laws governing food safety are outdated, inadequate or fragmented.[35] The provisions relating to animal health, for instance, can be found in multiple statutes, codes and standards (both legal and voluntary), which spurs institutional rivalries and blurs the boundaries of responsibility. There is inadequate protection of consumers from contaminated food products, fraudulent practices and the importation of substandard food for domestic markets.[36] Furthermore, enforcement of food law remains an important concern. The absence of a coherent policy framework for food safety has created an environment in which these government agencies operate according to their own institutional perspectives on food safety, often leading to effort duplication.[37]

The African Regional Office of the WHO highlights the inadequate address of food safety concerns in national policies in the African region and recommends national food safety policy coherence to be the foundation for effective food safety management systems.[38] While linked, these are, in reality, two different issues. The letter of food safety policies, i.e. policy content, are based on regulation inherited from Africa's former colonial masters. Food safety governance in the region, like many institutions on the continent, cannot be easily separated from the legacy of colonialism.

[32] Mwacalimba (2013).

[33] WHO-AFRO (2012).

[34] The Codex Alimentarius Commission was established jointly by the United Nations' (UN) Food and Agriculture Organization (FAO), and the World Health Organization (WHO).

[35] *Ibid.*

[36] *Ibid.*

[37] FAO/WHO (2005).

[38] WHO-AFRO (2012).

Many existing laws are rooted in legislation that was created during the colonial period and are, therefore, not properly oriented towards contemporary realities. So, while secondary legislation through statutory instruments may help address some concerns, it is the underlying definitions, institutions and authorities that form the basis of the foundational legislation that needs to be reformulated. Therefore, while it is true that the inadequate address of food safety concerns in national food safety regulations hampers the effectiveness of government responses to the issue, the lack of movement may also be due to the myriad of issues governments have to deal with using limited resources.

These issues are also symptomatic of a fragmented polity. Some researchers[39] explain that fragmentation is the norm in contemporary policy, where different sectors of government work as so-called silos, pursuing individual sector interests and mandates. As would be expected in a fragmented polity, the key institutions involved in food safety governance and the implementation of risk management for the protection of public, animal and environmental health, all operate with different priorities, agendas and mandates. Each institution along the supply chain has a different value system. How various stakeholders perceive food safety, i.e., as either "low politics" or "high politics,"[40] also affects overall policy coherence. Others[41] suggest that while issues of "high politics" or those of macro or systemic importance may be formulated and imposed by a narrow group of elites, those of "low politics" are subject to the influence of many different groups. Certainly, the interaction of low and high politics amongst the various international and national stakeholders involved in food safety governance in the African region provide an interesting dynamic to the management of food-borne risks to public health.

The food safety governance boundaries in the African region are also shaped through legislation and international standards adopted within the respective mandates of national and international institutions. The confusion only increases when regional and global actors in food safety governance come into play. A WHO study examining the status of food law in Africa suggested that in most African countries, there existed a discord between national food law and international requirements, such as the *Codex Alimentarius*. The study further states that this discord has led to the rejection of food exports from the region.[42] Such complex phenomena, however, cannot be treated as mere events, but should be considered institutionally embedded processes with distinct histories that need to be uncovered to help illuminate more general problems,[43] especially where many countries in the region face several non-tariff barriers that limit their ability to export their produce. These include Sanitary and Phytosanitary (SPS) requirements, technical barriers to trade, quotas, and market standards, restrictive rules of origin and complex tariff

[39]Kingdon (2003).

[40]Walt and Gilson (1994), Buse et al. (2005).

[41]Walt (1994).

[42]WHO-AFRO (2012).

[43]Omamo and Farrington (2004).

structures and import requirements.[44] The enforcement of import controls and inspections is also problematic for most governments, which presents the risk of importing unsafe and substandard food and food products.[45] A report[46] on Zambia, for example, argues that European Union (EU) and United States of America SPS standards are "dynamic" and have resulted in the rejection of Zambian goods at ports of entry. Others[47] state that EU standards for food safety are high to meet the perceived requirements of its affluent consumers. The following will shed further light on the case of Zambia.

42.2 Legislative Overlap in Food Law Governance

42.2.1 The Case of Zambia

First, the key ministry in charge of food safety in Zambia is the Ministry of Health, which is responsible for the review of law and policies, as well as the mobilization of resources to monitor and evaluate the quality of the health care delivery system. Enshrined in law (The Public Health Act Cap 295[48] and The Food and Drugs Act, Cap 303[49] of the Laws of Zambia), the Ministry is charged with protecting the

[44]Ndulo (2006).

[45]WHO-AFRO (2012).

[46]Mudenda (2005).

[47]Barling and Lang (2004).

[48]The date of the original text for this law is April 11th, 1930. It was last consolidated in 2006. The Act 'makes provision with respect to matters affecting public health in Zambia including prevention and suppression of infectious diseases including diseases communicable from animal to man, sanitation, protection of food, supply of water, protection from mosquitoes and pollution in general.

The Minister is granted certain regulation-making powers in respect of infectious diseases. Importation of animals may be restricted. The Act also prohibits the sale of unwholesome food and grants in general regulation-making powers to the Minister especially for the control of quality and hygiene of food. Water shall be kept in such a manner so as to avoid stagnant water. Local authorities shall take all possible measure for the prevention of the pollution of water and to purify any polluted water supply. The Minister may make, on the recommendation of the Central Board of Health, certain Orders for the protection of milk.

Descriptors (Livestock): animal health; pests/diseases; data collection/reporting

Descriptors (Food): food quality control/food safety; hygiene/sanitary procedures; milk/dairy products

Descriptors (Water): water supply; freshwater quality/freshwater pollution

Descriptors (Waste & hazardous substances): pollution control; waste disposal' Cap 295 of the Laws of Zambia.

[49]This act originated as S.I. No. 244 of 1972 as at 2006. The Food and Drugs regulations 'prescribe that no manufacturer or distributor of, or dealer in, any article shall sell such article to a vendor unless he gives to the vendor a warranty in a form set out in the Schedule and applicable to such sale. "Article" in the Act means any food, drug, cosmetic or device and any labelling or advertising

public from food hazards, be they chemical, physical or chemical agents. To achieve this, the Ministry monitors food quality and safety along the production chain using set standards, usually developed by the Zambia Bureau of Standards (ZBS). Interestingly, while the health ministry operates under compulsory legal guidelines such as the Public Health Act and the Food and Drugs Act, the standards created by the ZBS are voluntary.[50] Consequently, industry is under no obligation to comply with ZBS standards.

Second, Zambia's Agricultural Ministry's mandate focuses on animal and plant health. Its responsibility is animal disease control and the prevention of novel plant pest incursions into the country. The veterinary department, under the Ministry of Agriculture, is responsible for controlling hazards that may enter the food chain through food of animal origin. The Ministry of Agriculture draws on the Stock Diseases Act Cap 252 of 2010, which repealed the Stock Diseases Act of 1961,[51] and the Control of Goods Act Cap 421. Local government is responsible for meat inspection in abattoirs, the setting up of appropriate structures for animal slaughter and municipal waste management under Cap 281[52] of the Laws of Zambia. These legal mandates all empower these arms of government in food safety governance. It should be easy to see that there is considerable overlap when it comes to inspection of food of animal origin. Furthermore, the Public Health Act in Zambia does not cover many modern public health concerns in food processing and the Food and Drugs Act is superseded by international standards or country of export legal provisos, in cases of multilateral trade. This structure is fairly typical of many African countries.

In countries like Zambia, the informal sector, which plays a key role in food supply to the general population, is mostly considered to be outside the purview of official control mechanisms, except municipal authorities.[53] The sector is thus

materials in respect thereof or anything used for the preparation, preservation, packing or storing of any food, drug, cosmetic or device.

Descriptors (Livestock): animal health; drugs

Descriptors (Food): food quality control/food safety' Cap 303 of the Laws of Zambia.' Source: http://faolex.fao.org/.

[50]FAO (2005).

[51]The year this law was repelled is revealing. Zambia only became independent on October 24th, 1964.

[52]In some by-laws of this act, animal health and food safety is addressed. For instance, concern the slaughtering of animals and sale of meat in the area under the jurisdiction of the Katete District Council. They also provide for the control of stray animals.

'Butcheries shall be approved by the District Council. A person shall not expose, offer, deposit, accept or have in his or her possession for resale any meat unless such meat has been examined and passed by the Meat Inspector as fit for human consumption and stamped and marked accordingly.

Descriptors (Livestock): grazing/transhumance; slaughtering

Descriptors (Food): food quality control/food safety; meat; slaughtering; inspection' Source: http://faolex.fao.org/.

[53]WHO-AFRO (2012).

usually beyond the purview of official control and falls prey to substandard practices in the marketing of food products. In some cases, foods are processed and sold in unhygienic environments with little regard for cold chain requirements and pest control, for instance in the case of the street vending of raw and cooked food, a significant risk for food safety. Given the complicated mix of actors affecting the regulatory environment for food safety in Africa, in addition to the continent's rampant and myriad disease problems, inadequate or outdated legislation, solutions to the continent's problems in food safety are difficult to find.

42.2.2 The World Organization for Animal Health and Food Safety

An important international body in food safety regulation with regard to food of animal origin is the World Organization for Animal Health (OIE).[54] It was established on January 25, 1924, and is headquartered in Paris, France. It is not a United Nations body, like the Food and Agricultural Organization (FAO) and WHO, but the World Trade Organization (WTO) recognizes the OIE as a reference organization.[55] Thus the OIE has adopted an active pro-trade stance in their address of issues surrounding trade, health protection and food safety. In its Terrestrial Animal Health Code, the OIE lists international animal health standards that are the basis for facilitating safe trade in animals and animal products, standards that are recognized under the Sanitary and Phytosanitary (SPS) Agreement of the WTO.[56] Countries that are involved in animal and animal product trade are expected to comply with the SPS Agreement in order to reap the full benefits of international trade.[57] The SPS Agreement states that public health measures to ensure food safety and to control plant or animal diseases should be based, as far as appropriate, on international standards.[58] In addition, the SPS Agreement sets forth that measures to protect public health, animal health and plant health should only minimally interfere with trade. On issues of food safety, however, it must be noted that produce from developing countries, particularly those from the African region, cannot easily enter the more lucrative Western markets. Furthermore, both weak national food governance legislation and the facilitative intent of the SPS Agreement biased towards trade, may compound the problem of the importation of substandard food and food products. Therefore, the view that measures to protect health should only minimally interfere with trade remains problematic.

[54]This is the French acronym (Office International des Epizooties—OIE).

[55]Thiermann (2005), pp. 101–108.

[56]Bruckner (2009), pp. 141–146; OIE (2010); OIE (2004).

[57]Thiermann (2005).

[58]Zepeda et al. (2005), pp. 125–140.

The OIE's Terrestrial Animal Health Code prescribes the role that national veterinary services of member countries should play in food safety governance. It is the OIE's position that a veterinarian's background and training places him or her in a unique position as far as the assurance of food safety of foods of animal origin is concerned, emphasizing the proper training of veterinarians to meet the challenges in food safety. It also provides guidelines for evaluating national veterinary services. Interestingly, the OIE's veterinary services evaluation process sets independence from political influence as a primary benchmark.[59] The OIE's aim of separating science from politics is impractical. In fact, it has been suggested that the veterinary profession is likely limited by its dependence on scientific or authoritative opinion and its exclusion of political and social phenomena.[60] For food safety in particular, influencing policymaker perceptions on the human risks of diseases from livestock, cannot only be an exercise in science, it must also recognize politics.[61]

42.3 The African Agroecosystem: International Legal Perspectives of Epidemiology and Disease Control

Now we examine the international policy scenario as it relates to the African agroecosystem and disease control. Globalization under the current multilateral trading system has created vast inequalities between the world's richest and poorest nations.[62] Even the OIE's perspective on global issues, particularly its views on trade, has significant impacts on developing countries such as those found in the African region. Before the OIE disease lists were revised, of the 15 "List A Diseases" considered to be transboundary in nature and prioritized as threats to global animal health in the trade of livestock products, 12 were endemic to sub-Saharan Africa.[63] The presence of transboundary animal diseases in the African region and their unlikely eradication in the foreseeable future means that under WTO global trade rules, these countries will continue to be excluded from involvement in international trade.[64] Many countries in the African region have to deal with a range of animal diseases simultaneously, and are likely to continue doing so. This makes technical considerations and regulation of trade extremely difficult, even within a facilitative global trade environment.[65] Some publications,[66] for

[59]e.g. Vallat and Pastoret (2009), pp. 503–510.

[60]Hueston (2003), pp. 3–12.

[61]Green (2012), pp. 377–381; Mwacalimba and Green (2014).

[62]Stiglitz (2009), pp. 363–365.

[63]Thomson et al. (2004), pp. 429–433.

[64]*Ibid*.

[65]Upton and Otte (2004).

[66]Rweyemamu and Astudillo (2002), pp. 765–773.

example, suggest that the global distribution of Foot and Mouth Disease (FMD) interestingly mirrors the global economic make-up with industrialized countries generally being free of the disease while developing countries are endemic. Furthermore, reviews of WTO agreements and their effect on livestock production and trade in Africa, highlight the lack of transparency and equality among negotiating countries that has excluded many developing countries.[67] Sub-Saharan Africa has given out more concessions on tariff reduction than what it received from its trading partners.[68] This state pushes trade in a North–south direction and, unfortunately, international standards have been used to reinforced this direction of trade, primarily on health grounds.[69]

As was the case with food safety monitoring mechanisms, developing countries such as those found in the African region have serious problems in their surveillance systems and veterinary infrastructure.[70] With these problems, Africa's trading partners automatically assume that products exported from the continent are risky.[71] Focusing on development, some researchers[72] have argued that WTO SPS measures marginalize the world's poor producers the most and may even contribute to global poverty and disease. A review of the history of free trade[73] argues that current approaches to global trade deny poorer countries the opportunity to implement policies that fostered the development of the world's wealthy economies. These arguments suggest that developing countries are not only purposefully restricted from participating in global trade in reciprocal ways, their development opportunities are also restricted by these multilateral systems.

The dominant international perspective is that the African region and similar developing world contexts, pose the greatest risk as sources of infectious diseases.[74] Some[75] state, for instance, that the FAO's philosophy is to control these diseases at their developing country source. This view that resource-constrained countries are the biggest sources of infectious disease risks for the rest of the globe also suggests that disease control efforts would focus on the "global impacting" disease problems. It further implies a fostering of particular methods of control that may not be appropriate for different settings, which could actually harm local livelihoods or worse, encourage further disease spread.[76] The issues

[67] Tambi and Bessin (2006).

[68] see also MacDonald and Horton (2009) pp. 273–274.

[69] Mwacalimba (2013).

[70] Stärk et al. (2006), p. 20; Zepeda et al. (2005).

[71] Tambi and Bessin (2006).

[72] Hall et al. (2004), pp. 425–444.

[73] Chang (2003).

[74] Hampson (1997), pp. S8–S13; Domenech et al. (2006), pp. 90–107; Kruk (2008), pp. 529–534.

[75] Domenech et al. (2006).

[76] see Scoones (2010).

that lie at the confluence of health and trade also impact food safety and food safety governance.

The resulting "controlling-risk-at-source" narrative obscures the cultural, disease management and stigmatization challenges that the African region faces when its member states strive to embrace these global perspectives on trade and infectious disease control. For instance, livestock in many countries in the African region are not just kept as articles of commerce, but have cultural significance as well, what some[77] term multifunctionality; where they serve such functions as assuring domestic food security, provide access to nutrition for the less privileged and play key roles in the maintenance of distinctive rural cultures and ways of life.[78] Furthermore, compared to more industrialized countries where there are mechanisms for farmer compensation following livestock culling, this is not usually possible in resource-limited countries because of a dependency on livestock for rural livelihoods and difficulties in obtaining replacement stock.[79] In addition, although the two systems are sometimes loosely integrated, it must be understood that both traditional and commercial production practices co-exist in many of these contexts. Finally, it is possible that the diseases and risks prioritized in the global West are not necessarily the ones of most significance in these contexts. Therefore, part of the problem with this global aversion to infectious disease risk is that there is little effort made to understand the context in which developing countries attempt to negotiate global imperatives, be they public health, animal health or trade concerns. In the context of food safety in particular, not much has been done to investigate context-relevant ways of addressing these problems.[80]

42.3.1 Zoonotic Tuberculosis and Food Safety in Africa

To explain the links between zoonotic tuberculosis and food safety in Africa, it is important to first define and describe the wildlife-livestock interface. The wildlife-livestock interface can be simply defined as an area in which both wildlife and livestock commonly reside.[81] This definition, however, does not adequately capture the dynamic nature of this interface. Its nature is best defined by the context in which it exists. Kock,[82] provides several interesting contextual descriptions of what constitutes a wildlife-livestock interface, including migratory bird contact with intensive pig operations in North America, China and Europe, and pastoral cattle

[77]Smith et al. (2002).

[78]Mwacalimba et al. (2013), pp. 274–279.

[79]Zinsstag et al. (2007), pp. 527–531.

[80]Mwacalimba (2013).

[81]Grootenhuis and Olubayo (1993), pp. 55–59.

[82]Kock (2003), ftp://ftp.fao.org/docrep/nonfao/LEAD/x6198e/x6198e00.pdf.

foraging in African wildlife sanctuaries. The key descriptors of the interface include health, conservation, culture and economics. In the next segment, this chapter will focus on cattle production, the transmission dynamics of bovine tuberculosis (BTB) between cattle and wildlife reservoirs, the pertinent food safety concerns in the agroeconomy of wildlife-livestock interface and their implications for public health. It will also attempt to highlight key cultural and economic details of the interaction of these myriad facets that are important for food safety governance.

42.3.2 Epidemiology of Zoonotic Tuberculosis

Mycobacterium bovis is a member of the mycobacterium tuberculosis complex.[83] The bacterium causes Bovine tuberculosis (BTB), a zoonosis characterized by the development of specific granulomatous lesions in the lung, lymph nodes and other tissues.[84] Comparative genomics suggest that *M. bovis* evolved from *Mycobacterium tuberculosis*, the primary cause of human TB, but has since developed a capacity for infecting a large host range.[85] BTB's susceptible species range spans domestic and wild animal species, and man.[86] Although the specifics of the evolutionary biology of the two infectious agents remain controversial,[87] one school of thought is that the deletions in the *M. bovis* genome that occurred from its evolution from *M. tuberculosis* increased its host range.[88] *Mycobacterium bovis* is hardy, and can survive outside the host depending on environmental conditions. It can survive for up to 2 years in the environment, 1 year within dung pats, and between 5 and 7 months in manure, slurry or water.[89]

In Africa, approximately 85 % of cattle and 82 % of humans live in areas where BTB is either partly controlled or not controlled at all.[90] Like many of the African region's disease problems, a clear picture of the extent of the problem is yet to be developed. There is a paucity of data on the prevalence of BTB in cattle, a lack of species differentiation of human TB isolates and the presence of significant wildlife reservoirs.[91] The epidemiology of the condition in cattle is as follows: A vast majority of cattle excrete *M. bovis* almost from the inception of a lesion.[92] However, it is still not fully understood to what extent tuberculosis latency exists in

[83] O'Reilly and Daborn (1995), pp. 1–46.

[84] Ayele et al. (2004), pp. 924–937.

[85] Colston (2001); Gibson et al. (2004), pp. 431–434.

[86] Niemann et al. (2000), pp. 152–157.

[87] Brosch et al. (2002), pp. 3684–3689.

[88] Colston (2001).

[89] Hancox (2000), pp. 87–93.

[90] Cosivi et al. (1998).

[91] Ayele et al. (2004), pp. 924–937.

[92] Menzies and Neill (2000), pp. 92–106.

cattle and the associated problems of this potential source of infection. BTB will persist in cattle as long as the bovine host lives.[93] A single bacillus that becomes aerosolized is sufficient to establish infection, droplet size being more important than number of bacilli.[94] With droplet nuclei as a vector, animals do not need to be in close contact with a tuberculosis disseminator to become infected.[95] We must cross reference this scientific fact with the social role that cattle play in African rural culture and livelihood i.e. not as a source of food, but a status symbol. This is important for understanding disease transmission in the wildlife-livestock interface.

In humans, tuberculosis caused by *M. bovis* is similar to *M. tuberculosis*.[96] Infection occurs via aerosol inhalation due to close contact with infected cattle,[97] oral consumption of infected food, and through skin wounds.[98] In a broad sense, these routes of infection are all important, but it must be understood that BTB is predominantly a milk-borne zoonosis.[99] During the pre-eradication period in western countries, milk was the main source of infection for human beings, especially children.[100] Studies have been done where *M. bovis* has been isolated from milk in Africa.[101] In cases were the bacillus enters a human being orally, i.e. through the ingestion of unpasteurized and BTB contaminated milk or milk products, disease manifestation is mainly extra pulmonary with abdominal, bone and joint forms, as well as infection of cervical and mesenteric lymph nodes.[102]

Humans in close contact with infected cattle may acquire *M. bovis* via the respiratory route.[103] Gibson et al.[104] discuss a case from Gloucester in which a 20 year-old male became infected with *M. bovis* following inhalation of infectious aerosols. He was frequently sprayed with nasal mucus from cattle. He is thought to have later infected his sister who was diabetic and pregnant, thus immunocompromised. Similar transmission may occur in pastoral communities in individuals who frequently handle their livestock or infected wildlife meat and secretions.

Meat from infected animals may also contain viable *M. bovis*[105] that could pose a risk of infection for humans. Specific tissues such as liver, spleen, kidney, mammary glands and lymph nodes may contain sufficient organisms detectable by culture or guinea pig inoculation, even though not showing evidence of infection

[93]Hancox (2000).

[94]Menzies and Neill (2000).

[95]*Ibid.*

[96]O'Reilly and Daborn (1995); Cosivi et al. (1998).

[97]Moda et al. (1996), pp. 103–108; Grange (2001); Mfinanga et al. (2003a, b), pp. 933–941.

[98]Wilkins (2000).

[99]Unger et al. (2003).

[100]O'Reilly and Daborn (1995); Grange (2001).

[101]Ameni et al. (2003).

[102]Unger et al. (2003).

[103]Moda et al. (1996); Grange (2001); Mfinanga et al. (2003a, b), pp. 695–704.

[104]Gibson et al. (2004).

[105]Aranaz et al. (2004), pp. 2602–2608.

at necropsy.[106] Haematogenous spread is believed to be responsible for secondary lesions.[107] Thus meat and blood from infected animals pose potential risks of zoonotic infection if not properly prepared or if consumed raw.[108]

In Africa, the relative proportion of human tuberculosis cases caused by *M. bovis* is unknown because differentiation from infections caused by *M. tuberculosis* is not commonly performed.[109] However, significant risk factors for the transmission of *M. bovis* occur in communities where there is close human-to-livestock contact.[110] Some[111] estimate that in countries where pasteurization of milk is rare and bovine tuberculosis is common,[112] 10–15 % of human cases are caused by *M. bovis*. In many rural parts of the African region, BTB control is nonexistent and poor food hygiene practices, husbandry methods, and consumption of raw milk still present risks of human infection.[113] Infection in these areas is by ingestion of unpasteurized milk, poorly cooked meat and close contact with infected animals, tissues or secretions.[114] In pastoralist communities of Northern and Southern zones of Tanzania, for instance, 16 % of culture-positive mycobacteria isolates from human cases were *M. bovis*.[115] Kazwala[116] states that there was a definite link between the number of cattle owned and the incidence of non-pulmonary tuberculosis in the human population. Similarly, the ownership of reactor cattle herds in Zambia was shown to be statistically associated with human tuberculosis cases,[117] although in other countries no statistically significant association between reactor cattle and associated households was found, even though there were human tuberculosis cases in households that owned reactor cattle.[118]

Grange[119] cites other studies that exemplify human cases of *M. bovis* in Africa. This includes surveys where 0.4, 5.4 and 6.4 % of pulmonary tuberculosis cases respectively were due to *M. bovis* in Egypt, while 3.9 % of 102 isolates of pulmonary tuberculosis was due *M. bovis* in Nigeria. Prior to effective tuberculosis control in cattle in developing countries, the positive correlation between human prevalence and infection was well recognized. Up to 6 % of human pulmonary

[106]FSAI Scientific Committee (2003), http://www.fsai.ie/publications/other/zoonotic_tuberculosis.pdf.

[107]Neill et al. (2001).

[108]Moda et al. (1996).

[109]Moda et al. (1996); Kazwala et al. (2001), pp. 87–91.

[110]Mfinanga et al. (2003a, b).

[111]cited by Unger et al. (2003).

[112]Tamiru et al. (2013), pp. 288–295.

[113]Ameni et al. (2003).

[114]Ayele et al. (2004).

[115]Kazwala et al. (2001).

[116]*Ibid.*

[117]Cook et al. (1996).

[118]Ameni et al. (2003).

[119]Grange (2001).

tuberculosis cases were attributed to infection of bovine origin in the south of England between 1931 and 1937.[120] In one review,[121] pulmonary disease was found to be more common in rural areas of England and Wales in the early part of the twentieth century, possibly due to aerogenous infection from cattle. The current situation in Africa is thought to be similar to the pre-eradication era in Europe.[122]

Finally, although human-to-human transmission is considered rare,[123] other humans with *M. bovis* infection may be potential sources of disease. The highest risk groups for acquiring *M. bovis* are individuals with concomitant HIV/AIDS infection.[124] Thus the high prevalence of HIV/AIDS in sub-Saharan Africa is an added risk. Transmission among HIV infected individuals may be particularly high because immunosuppression increases susceptibility to infection.[125] Some researchers[126] suggest that most TB cases in African HIV/AIDS patients are due to exogenous re-infection rather than reactivation of endogenous *M. tuberculosis* and could have a similar risk of exogenous disease upon exposure to *M. bovis*. In such individuals, it may be difficult to determine if the zoonosis is a reactivation or a new infection.[127]

42.4 Malevolence or Benevolence? Issues at the Nexus of Food Safety and Food Security in the Wildlife-Livestock Interface of Southern Zambia

In Zambia the incidence of HIV has been steadily declining since the 1990s. However, according to country statistics, the HIV prevalence still stands at 12.7 % while human TB is at 433 per 100,000 of the population.[128] The reduction in HIV incidence is a result of control strategies instituted by the government, with the support of donor agencies such as the Global Fund to Fight AIDS, Tuberculosis and Malaria. In this country, research has demonstrated that BTB may be an important neglected disease whose impact on public health is underestimated because of the high prevalence of human TB coupled with the ongoing HIV/AIDS pandemic.[129]

One area where BTB may be significant is in a wildlife-livestock interface area in the south of Zambia, in the flood plains of the 6500 km^2 Kafue Flats. Lochinvar and Blue Lagoon national parks are two contiguous Game Management Areas in the catchment of the Kafue Flats in which human settlement, small-scale

[120] O'Reilly and Daborn (1995).
[121] Grange (2001).
[122] Ayele et al. (2004).
[123] O'Reilly and Daborn (1995); Grange (2001).
[124] Ayele et al. (2004).
[125] *Ibid.*
[126] cited by Ayele et al. (2004).
[127] Zumla et al. (2000), pp. 259–268.
[128] UNGASS (2012).
[129] Mwacalimba et al. (2013).

agriculture, livestock production and fishing are permitted. This area brings the nexus of food safety, disease control and risk into sharp focus. The risk factors for the zoonotic transmission of the disease to humans in this area include livestock management methods, food preparation and hygiene methods, and socio-economic and health status.[130]

The Tonga and Ila tribes constitute the largest ethnic groups living in this area. Their main economy is livestock production.[131] Their cattle are kept for prestige, milk, draft power, dowry, savings and to offset crop failure[132] and are rarely slaughtered except during ceremonies.[133] Cattle rearing in this area is predominantly pastoral with grazing based on the cycle of flooding in the floodplains, which provides year-round pasture. Nearly three quarters of the area's cattle graze in the floodplains for 6 months out of every year.[134] There are three contiguous herding systems practiced in this area. In village resident herding, cattle are reared in and around villages. Transhumant grazing involves the trekking of cattle into the floodplains during the dry season. These herds return to the villages when the rains start and pasture becomes abundant closer to the villages. The last herding system is interface herding. These are large herds of cattle whose numbers cannot be supported by pasture around the villages.[135] Transhumant and interface cattle interact freely with wildlife such as the Kafue lechwe (*Kobus leche kafuensis*).[136] This is a highly sociable semi-aquatic marsh antelope that can only be found in the floodplains in and around Lochinvar and Blue Lagoon National Parks.[137] It is[138] estimated that the herd level prevalence of BTB in cattle from this area at 49.8 %, while the individual cattle prevalence was estimated around 6.8 %.

The first zoonotic TB food-borne risk comes from cattle as a milk source for local communities and human contact with infected herds. As stated earlier, BTB is primarily a milk-borne zoonosis. Some[139] estimate that 50 % of milk derived from these cattle is consumed locally. Pasteurization is able to kill *M. bovis* in milk[140] but where this is not done, human infection is likely to occur. The milk consumed in the wildlife-livestock interface is rarely pasteurized and is sometimes consumed as curdled or soured milk, which is considered a delicacy. The local breeds of cattle are not bred for milk production, and, hence, have low outputs. Thus, milk pooling is a common practice, which increases the risk of humans acquiring BTB from

[130] Munyeme et al. (2010a, b).

[131] Mumba (2004).

[132] Mwacalimba et al. (2013).

[133] Cook et al. (1996).

[134] Chabwela and Mumba (1998).

[135] Munyeme et al. (2008).

[136] *Ibid.*

[137] Mumba (2004); see also Phiri et al. (2011), pp. 20–27.

[138] Munyeme et al. (2008).

[139] Mumba et al. (2011), p. 137.

[140] Kells and Lear (1959).

milk. Although only 1 % of cattle with BTB excrete *M. bovis* in their udders, infected milk from a single cow can contain enough viable bacilli to contaminate milk from up to 100 cows if pooled.[141] Furthermore, *M. bovis* has been shown to survive in soured milk for up to 14 days.[142]

The second zoonotic food-borne risk comes from wildlife. The predominant species and primary wildlife maintenance host for BTB is the Kafue lechwe.[143] There is a single population of lechwe in the floodplain coexisting with humans and livestock herds.[144] Dated reports on BTB burden in lechwe are varied, estimating the prevalence around 14 and 30 %.[145] In a 2010 study,[146] Munyeme and his colleagues estimated the prevalence of BTB in hunter-harvested lechwe to be around 24.3 %. These findings represent the risk to public health for the communities living in and around the wildlife-livestock interface.

The food safety significance of lechwe lies in the fact that, of all the wild animal species in Zambia, this small antelope is the most sought after species for game meat.[147] The legal off-take of lechwe amounts to around 800 lechwe a year.[148] An estimated 47.7 tonnes of lechwe meat is produced annually and consumed by about 39,780 people.[149] Poaching, of course, remains a significant problem for this and other species of wildlife. However, the concern here is that even meat obtained legally (through the official quota utilization system) by members of the community is not subject to food safety enforcement mechanisms such as meat inspection. In Africa, abattoir inspected meat is usually consumed in urban areas[150] while rural communities do not routinely submit their animals for meat inspection. For Zambia, wildlife conservation usually occurs in areas remote to veterinary services.[151] The result is that game continues to be consumed, and wildlife trophies handled, without veterinary clearance. The implication of this is that, while providing local communities access to meat from the Kafue lechwe offers an important source of supplementary protein, the food derived from this source also carries the risk of transmission of zoonotic tuberculosis.

Of course, there are other routes available for the zoonotic transmission of BTB, as the aforementioned epidemiological review of *M. bovis* has tried to demonstrate. Therefore the food safety and infectious disease dangers to the communities living in and around the wildlife-livestock interface are very real. Clearly, BTB may play

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[141] Ameni et al. (2003).
[142] Kazwala et al. (2001); Ayele et al. (2004).
[143] Munyeme and Munang'andu (2011).
[144] Jeffery et al. (1991), cited by Kock et al. (2002), pp. 482–484.
[145] Cook et al. (1996); Cosivi et al. (1998); Pandey (2004), pp. 17–20.
[146] Munyeme et al. (2010a, b), pp. 305–308.
[147] Siamudaala et al. (2003).
[148] Simasiku et al. (2008).
[149] Siamudaala et al. (2003).
[150] Ayele et al. (2004).
[151] Siamudaala (2004), pp. 48–52.

a role in the epidemiology of human TB, particularly in the context of HIV and AIDS. However it is rarely, if ever, linked to the policy narratives that focus on the big three; tuberculosis, HIV and malaria. Furthermore, while the scientific literature has linked wildlife management, community nutrition and livestock husbandry to BTB epidemiology and risk, the relevant policy actors in this triad have not been appropriately engaged and thus BTB remains a neglected disease with real consequences. Based on data extrapolated from other countries and the prevalence of human tuberculosis in the region, it was estimated that over a 10 year period, around $1.5 million (US) are costs attributable to the treatment of zoonotic tuberculosis in this area.[152]

42.4.1 Avian Influenza: The Zambian Experience of Pandemics and Food

42.4.1.1 The Epidemiology of Highly Pathogenic Avian Influenza H5N1 Spread and the International Response

The infamous H5N1 highly pathogenic avian influenza (HPAI)[153] was first identified at a goose farm in Guangdong Province, southern China in 1996.[154] Subsequently, high H5N1-related mortalities were reported on three chicken farms in Hong Kong, just adjacent to Guangdong Province, between March and early May, 1997.[155] In May of the same year, a child died of viral pneumonia, the first reported case of zoonotic H5N1 influenza.[156] Following the identification of 17 more human infections that resulted in five deaths between November and December of 1997,[157] H5N1 became recognized as a zoonosis of possible public health concern. As a result, in December 1997, total and rapid depopulation of all poultry in markets and chicken farms in Hong Kong was carried out to control the outbreak, a move that both policy and virology experts believed had averted a potential human pandemic.[158] Arguably, live poultry markets were important in the transmission of the H5N1 virus to other avian species and humans during these outbreaks.[159] The control measures instituted, i.e. the total culling of all farmed chickens and all poultry in markets in Hong Kong, appeared effective, as the responsible genotype

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[152] Mwacalimba et al. (2013).

[153] Avian influenza exists in two forms, highly pathogenic avian influenza (HPAI) and low pathogenic avian influenza (LPAI). Continuous existence of LPAI virus in avian populations may provide chances for the virus to undergo mutation and convert to a highly pathogenic form. Highly pathogenic avian influenza, especially of the H5 and H7 subtypes, has the potential to infect human beings.

[154] Xu et al. (1999), pp. 15–19; Webster et al. (2002), pp. 118–126.

[155] Shortridge et al. (1998), pp. 331–342.

[156] *Ibid.*

[157] *Ibid.*

[158] Fidler (2004b), pp. 799–804; WHO (2005b); Webster and Hulse (2005), pp. 415–416.

[159] Shortridge et al. (1998).

of H5N1 (A/goose/Guangdong/1/96) has not been reported since the execution of these controls.[160] However in February 2003, during the SARS epidemic, and after a 6-year hiatus, three more human H5N1 infections with two fatalities were identified in China. This suggested viral persistence, despite the control measures that had been instituted in 1997.[161] An epidemiological review[162] states that outbreaks had continued to occur in poultry in Hong Kong from 2001 to early 2002, caused by a different H5N1 lineage. While there is some suggestion that the H5N1 problem had been subdued in 1997,[163] it was, in fact, entrenching itself in the poultry systems of Hong Kong, and likely elsewhere in Southeast Asia, between 1997 and 2003.

Between December 2003 and February 2004, the first wave of an H5N1 panzootic in poultry was reported nearly simultaneously in eight countries in South and Southeast Asia, most of which occurred in commercial poultry establishments. This was followed by a second wave of spread from July 2004.[164] The WHO states that the second wave was associated with more rural settings.[165] The countries initially affected were China, Indonesia, Cambodia, Japan, Laos, Korea, Thailand and Vietnam, with a ninth country, Malaysia, joining the list in August 2004.[166] The pro-poor advocacy group, GRAIN, states that the initial outbreaks in Vietnam, Thailand, Cambodia, Laos and Indonesia all occurred in closed, intensive factory farms.[167] During the first wave, millions of poultry either died or were culled in an effort to control the disease.[168] Human infections were then reported in Hanoi, Vietnam, in January, 2004, a few days prior to a report of massive H5N1-related poultry mortalities in two poultry farms in the south of the country.[169] Vietnam had initially experienced an H5N1 outbreak in 2001.[170] In early 2004, during the first wave of the panzootic, the WHO declared the outbreak an unprecedented catastrophe for agriculture in Asia and a "global threat to human health."[171]

Coinciding with the second wave of the panzootic, the period between August and October 2004 saw eight more human deaths in Thailand and Vietnam.[172] The third wave began in December 2004, involving new poultry outbreaks in Indonesia, Thailand, Vietnam, Cambodia, Malaysia and Laos.[173] Fresh human cases were

[160]Sims et al. (2005), pp. 159–164.
[161]WHO (2005b).
[162]Sims et al. (2005).
[163]WHO (2005b).
[164]Alexander (2007); Paul et al. (2010).
[165]WHO (2005b).
[166]Sims et al. (2005).
[167]GRAIN (2007).
[168]WHO (2004), at http://www.who.int/mediacentre/releases/2004/pr7/en/.
[169]WHO (2005b).
[170]Sims et al. (2005); Sims and Narrod (2008).
[171]WHO (2004).
[172]WHO (2005b).
[173]WHO-AFRO (2005).

reported in Vietnam, Thailand and Cambodia.[174] At this point, after reviewing the unfolding situation, a writing committee of the WHO consultation on human influenza established that Vietnam led the human death toll.[175] According to a WHO pandemic threat report,[176] by 2005, H5N1 had crossed the species barrier three times, namely in 1997, 2003, and the period between 2004 and early 2005, which recorded the largest occurrence of human H5N1 cases of the period in question. With the report of migratory birds being affected with H5N1 in Mongolia and China, particularly at Lake Qinghai in China in April 2005, concern grew that this posed a potential risk of southward and westward spread of the virus in poultry.[177] Around 6345 birds of different species died in the weeks following the Qinghai outbreak.[178] This is probably the single most important event linking H5N1 to migratory bird spread. This outbreak singularly raised the profile of the role of migratory birds in the global spread of H5N1.

H5N1 had spread through the diverse market and poultry production systems of Southeast Asia. There is much debate around the primary causes and drivers of the H5N1 problem, revolving around poultry production and marketing practices. An important factor in the Asian panzootic is that ducks appeared to have played a key role in the maintenance of the virus, primarily as silent carriers of H5N1. While outbreaks in poultry were still possible, this suggests that in areas where duck production was less significant, the chances of endemicity could be lower. By 2005, H5N1 had become endemic in the duck population of poultry, providing a reservoir of the virus for other poultry species as asymptomatic shedders of H5N1 influenza.[179]

As of November 11, 2010, H5N1 HPAI had claimed a cumulative 508 confirmed cases and 304 human deaths.[180] The panzootic cost the global poultry industry well over $10 billion (US) in losses and continued to persist in poultry populations of parts of Europe, Southeast Asia, Egypt and Nigeria.[181] The primary public health concern had been H5N1's likely candidacy for the next human influenza pandemic, which many experts believed was overdue.[182] Interestingly, it was the rapid spread, public health and economic ramifications of the SARS outbreak in 2003 that appear to have alerted the global health community to the conceivable need for pandemic

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[174] *Ibid.*

[175] Beigel et al. (2005), pp. 1374–1385.

[176] WHO (2005a), http://www.who.int/csr/disease/influenza/H5N1-9reduit.pdf.

[177] Chen et al. (2005), pp. 191–192; Webster and Govorkova (2006), pp. 2174–2177; Alexander (2007), pp. 5637–5644; Cattoli et al. (2009), p. e4842.

[178] WHO (2005c).

[179] Webster and Hulse (2005); Sims et al. (2005); Sims and Narrod (2008), www.fao.org/avianflu.

[180] WHO (2010), http://www.who.int/csr/disease/avian_influenza/country/cases_table_2010_11_19/en/index.html.

[181] WHO (2005a, b); GRAIN (2006); Eurosurveillance (2006) E061221.1.; Kilpatrick at al. (2006), pp. 19368–19373; FAO (2010), www.fao.org/avianflu/en/maps.html.

[182] Conly and Johnston (2004), pp. 252–254; Kilpatrick et al. (2006); Bartlett (2006), pp. 141–144.

preparedness.[183] In the wake of SARS, H5N1 presented an unprecedented challenge to the animal health, public health and trade policy communities, identified as a threat to the poultry industry, a pharmaceutical interest, a trade-related epidemic, public health threat, and a human pandemic concern.[184]

For avian influenza, one[185] explanation is that public health experts and epidemiologists did not know whether an H5N1 human pandemic was actually imminent, only that it was plausible. Adding to the complexity was the need to determine how exactly to respond to a potential H5N1 pandemic. Reviewing available surveillance data on past human influenza pandemics, there was no pattern to the epidemiology of occurrence,[186] or standard manifestation of pandemics, including which segments of the population would be affected the most.[187] This suggests that there is no clear precedent for definitively predicting how the next pandemic will behave.

Despite these uncertainties, a multi-sectoral approach to H5N1 management and pandemic preparedness across the policy sectors affected was advocated at national, regional and international levels. The purpose of such an approach was to foster a coherent response to H5N1.[188] Correspondingly, the main thrust of the H5N1 avian and pandemic influenza response was the coordination of public health and animal health agencies at national and international levels with the goal of developing preparedness interventions for those areas that had not yet been affected. An alternative goal was to reinforce control measures in locations where the disease had become endemic, where, based on WHO pandemic preparedness guidelines, OIE recommended control measures and FAO devised surveillance strategies.[189] However, H5N1 presented unique challenges for pandemic planning, involving the weighing of sector-specific risk against wider ecological and socio-economic interests that challenged the traditional public health and animal health based interventions of the pre-SARS era. Global infectious disease governance post-SARS dictated, at least in the context of avian and pandemic influenza preparedness, the attempt to balance the interests of pharmaceutical, conservationist, transnational business and commercial poultry as well as bridge the previously growing divide between public and animal health.[190]

In the policy domain, many of the concerns over a pandemic began to sound apocalyptic. The often-cited comparator was the 1918 Spanish flu pandemic which

[183] Scoones and Forster (2008a).

[184] WHO (2006), www.who.int/csr/disease/avian_influenza/avian_faqs/en/index.html; ALive (2006); Karesh et al. (2005), pp. 1000–1002; Ong et al. (2008); Scoones and Forster (2008a).

[185] Osterholm (2005), pp. 1839–1842.

[186] Monto et al. (2006), pp. S92–S97.

[187] Nicoll (2005), pp. 210–211.

[188] Ong et al. (2008); UN (2010), http://www.un-influenza.org/node/4040.

[189] WHO (2005a); Webster and Hulse (2005).

[190] Fidler (2004a); WHO/DFID-AHP (2005); Fidler (2008), pp. 88–94; Scoones and Forster (2008b), http://www.steps-centre.org/PDFs/Avian%20flu%20final%20w%20cover.pdf; Rabinowitz et al. (2008), pp. 224–229.

one health policy scholar suggests killed over 50 million people.[191] This particular pandemic was said to have its origins in Kansas military camps and was spread to Europe by US troops during the war in 1918.[192] With contemporary concerns focusing on human population growth, increased intensity of production systems and the unprecedented nature of globalization, which many have argued allow for the faster and further transmission of infectious disease threats,[193] there was a fear that a pandemic in modern times could kill millions. Some researchers,[194] on the other hand, held the view that a pandemic now is likely to result in considerably lower deaths than the one that occurred in 1918. The WHO[195] estimated that a pandemic arising from H5N1 could result in two-seven million deaths at the minimum. Other commentators were skeptical[196] and dismissed the avian influenza issue, and SARS before it, as elaborate political conspiracies of corporate and pharmaceutical interests disguised as national security threats and pandemic concerns. There was, therefore, a lot of politics surrounding the issue of avian and pandemic influenza.

In the debates on global responses to avian influenza, some researchers[197] mapped recurring themes and summarize the four themes characterizing the core political issues: (1) risk and uncertainty, (2) economy and livelihood impacts, (3) effects on health and extent of disease, and (4) effects on food and farming. Drawing from these four issues, there are six linked debates identifiable in the international policy discourse concerning avian and pandemic influenza. The first debate involved the scientific uncertainty of the likelihood of the occurrence of a pandemic caused by H5N1. As mentioned above, some authors[198] state that public health experts were uncertain of its likelihood. The concern over a possible pandemic resulted in called to focus control on the likely source of this risk, such as Southeast Asia, where most of the impact of H5N1 had been felt. In fact, some authors have referred to Southeast Asia as an "influenza epicenter."[199] Of course, a complex interplay of cultural factors and production practices led to the exposure and eventual succumbing of humans in this region to H5N1.[200] These factors have been identified and reviewed in various context-specific network analyses,[201] HPAI risk

[191] Osterholm (2005).

[192] Webster (1997), pp. S14–S19; Hollenbeck (2005), pp. 87–90.

[193] Käferstein et al. (1997), pp. 503–510; Hampson (1997), pp. S8–S13; Kimball et al. (2005), p. 3; Kimball (2006).

[194] Morens and Fauci (2007), pp. 1018–1028.

[195] WHO (2006).

[196] Horowitz (2005).

[197] Scoones and Forster (2008a).

[198] Osterholm (2005).

[199] see Hampson (1997).

[200] see Webster (1997); Osterholm (2005).

[201] Van Kerkhove et al. (2009), pp. 6345–6352; Soares Magalhaes et al. (2010), p. 10.

mapping studies,[202] risk factor studies[203] and risk analysis.[204] However, in some reviews of infectious diseases risk management and governance of global risks,[205] it was argued that although surveillance had focused on H5N1, there was still a lot of uncertainty about both its evolution as a zoonosis and its effects on public health.

The second debate involved linking poultry production practices, HPAI epidemiology and disease spread through trade, poultry and poultry product and migratory bird movement. According to the epidemiological reviews by Capua and Alexander[206] and Alexander,[207] recent increases in intensive poultry production practices were responsible for the increasing incidence of highly pathogenic influenza in the world. It was stated by van den Berg[208] that all parts of the world were at risk of H5N1 incursions as a result of the globalization of trade. Some authors took the view that it was migratory birds that would spread H5N1 across the globe,[209] yet others claimed that wild birds were only capable of short range spread.[210]

The third debate involved the 'One Health' approach response to mitigate the pandemic threat. This was characterized by calls to strengthen veterinary control systems in addition to human pandemic preparedness, addressing the pandemic risk at-source but involving other sectors to mitigate the risk.[211] A key question here was how do countries incorporate other policy sectors in risk mitigation? As one study demonstrated, each sector, and indeed each country, would view the HPAI problem differently.[212] In addition, while the international community recommended 'at-source' controls, the 'standardized' approaches adopted worked in some areas and failed in others.[213] In their examination of the epidemiology of H5N1, Yee, Carpenter and Cardona,[214] state that control measures such as culling, disinfection and stamping out had been successful in controlling H5N1 outbreaks in Europe, but were not as effective in Southeast Asia.

The fourth debate involved the potential effects of a human pandemic on the global economy. This resulted in HPAI risk mitigation responses perceived to largely affect only the livelihoods of those in outbreak areas.[215] The brunt of these control efforts was largely felt by poor farmers, impacting on food security,

[202] Gilbert et al. (2008), pp. 4769–4774.
[203] Yupiana et al. (2010), pp. e800–e805.
[204] e.g. Kasemsuwan et al. (2009).
[205] Pitrelli and Sturloni (2007), pp. 336–343.
[206] Capua and Alexander (2004), pp. 393–404.
[207] Alexander (2007).
[208] van den Berg (2009), pp. 93–111.
[209] Normile (2006), p. 1225; Chen et al. (2005).
[210] See e.g. Webe and Stirlianakis (2007), pp. 1139–1143.
[211] FAO (2004); WHO (2005a).
[212] Mwacalimba and Green (2014).
[213] Scoones and Forster (2008b).
[214] Yee et al. (2009), pp. 325–340.
[215] Scoones and Forster (2008a).

livelihoods and farming. Stirling and Scoones,[216] for example, estimated that over 2 billion birds were slaughtered with the greatest losses suffered by the poor. Nicoll[217] states that the effect of H5N1 was mostly felt in the social sphere, particularly in Southeast Asia, where several countries (e.g. Thailand) had their poultry exports prejudiced and rural livelihoods affected by control interventions. This has links to contentions between business and livelihood interests and controversies over the role of intensive vs. backyard farming in disease spread.[218]

The fifth debate involved pharmaceutical interests, covering influenza virus sharing and concerns that genetic sequence information collected from outbreak areas would be used to create vaccines for market that would not be distributed equitably in case of a pandemic.[219] The policy response involved Western countries scrambling to stockpile antiviral drugs and vaccines for 'high level pandemic preparedness efforts', the vaccines of whose production depended on H5N1 virus strains recovered from outbreak centers in developing countries.[220] In an effort to globalize this policy response, there were calls for affected countries to either develop pharmaceutical capacity or consider non-pharmaceutical interventions.

Linked to this was the sixth debate, involving the 'securitization' framing of the avian and pandemic influenza issue, which, Elbe[221] argued, contributed to, and caused difficulty in resolving, the controversy over influenza virus sharing . In implementing this 'securitization' approach, Western countries spent massively on pandemic preparedness. Burgos and Otte's (2008) study[222] citing Jonas's study[223] state that the US and European countries had spent approximately US$2.8 billion 'at home' versus US$950 million 'abroad' for disease control 'at-source' by the end of 2008. This forms the background against which developing countries generated their avian and pandemic influenza intervention policies guided by the WHO global pandemic preparedness plan.[224]

The African response was coordinated by the WHO African Regional Office (WHO-AFRO), the African Union Inter-African Bureau for Animal Resources (AU-IBAR) and some regional trading blocs such as the Southern African Development Community (SADC), with funding from the African Union and the World Bank.[225] This was under the global coordination of United Nations System Influenza Coordinator (UNSIC), with the main participants being WHO, OIE and FAO.[226] These global and regional actors set out a framework to guide the

[216] Stirling and Scoones (2009); Scoones and Forster (2008b).

[217] Nicoll (2005).

[218] GRAIN (2006); GRAIN (2007).

[219] Garrett and Fidler (2007), p. e330; Fidler (2008).

[220] Elbe (2010), pp. 476–485.

[221] *Id.*

[222] Burgos and Otte (2008).

[223] Jonas (2008) cited by Burgos and Otte (2008).

[224] WHO (2005a); ALive (2006).

[225] WHO-AFRO (2005); ALive (2006); UNSIC and World Bank (2008).

[226] UNSIC (2006a, b); Scoones and Foster (2008a).

development of national avian and human influenza prevention and control responses. Among these guidelines was a recommendation for multi-sectoral integration.[227] By 2007, response plans on the African continent were at different stages of development with most aimed at containment of avian influenza in poultry to the neglect of pandemic preparedness.[228]

42.4.2 Chicken: A Cheap Source of Protein or a Pandemic Threat?

At the height of the global avian influenza crises, a WHO AFRO risk assessment made comparisons between Asian and African poultry production systems to justify the continent's risk of an incursion as well as recommend similar control measures to those used in Southeast Asia.[229] The statement read in part, 'Though the densities of human and poultry populations are generally lower in Africa than in south-east Asia, the poultry production systems have many similarities which could create multiple opportunities for human exposure, if outbreaks occur in African poultry'.[230] Despite the different contextual realities, such as the role that ducks, mixed farming, and wet markets played in the evolutionary epidemiology of avian influenza,[231] or the fact that Southeast Asia is considered to be a viral mixing pot most likely to be the epicenter for the emergence of novel viruses such as H5N1,[232] the unexamined underlying assumptions of this statement are what formed the mould for preparedness efforts in Africa.

In Zambia, the international call for pandemic preparedness was met first by local media reports of possible avian influenza outbreaks in Zambian poultry. The result was a nearly $7 million (US) loss to the poultry industry over a 3 month period as production scaled down.[233] Producers reduced their production, consumers feared the consequences of eating infected chicken and this had knock-on effects on the feed industry, the veterinary pharmaceutical industry and poultry breeders.[234] The reports of outbreaks in poultry turned out to be false. Under WHO and FAO oversight, the Zambian government commissioned a 20-person multi-sectoral task force on avian influenza at the end of October 2005, to be the nation's eyes and ears concerning avian and human influenza and prepare for what they perceived to be an inevitable incursion of H5N1 in the country.[235]

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227 WHO-AFRO (2005); UNSIC (2006a, b).

228 Ortu et al. (2008), pp. 161–169; Ortu et al. (2007).

229 WHO-AFRO (2005).

230 *Id.*, p. 7.

231 Mwacalimba (2012), pp. 391–405.

232 Hampson (1997).

233 Mwacalimba (2012).

234 *Ibid.*

235 GRZ (2006).

Early in the evolution of Zambia's response to avian and pandemic influenza, the threat of an incursion of H5N1 was successfully presented as an imminent threat. Between 2005 and 2009, this framing of the H5N1 threat as an emergency led to both government and academic scientists in the country searching for the elusive virus in both traditional poultry and wildlife.[236] The public response to media reports suggests a perception of a food safety concern. The perception of policy makers, however, reflected their institutional standpoints. For example, stakeholders from the Ministry of Health viewed it as a pandemic concern and a potential triage strain for the health system should human infections occur. The Agricultural Ministry, represented by the veterinary department, viewed it as an exotic poultry problem with the potential for zoonotic transmission. It was also viewed as likely to emerge from poor poultry producers with no knowledge of biosecurity. The Trade Ministry and poultry industry viewed it as a threat to both Zambia's poultry sector as a whole and Zambia's international trade opportunities.[237]

Around 64 % of Zambia's households keep chickens.[238] It provides an affordable source of protein for many of the country's citizens. Production is primarily traditional, based on the rearing of indigenous breeds with around 10–15 of chickens per household. The commercial sector in the country is a mix of backyard producers, emergent broiler and layer farmers supplied by locally produced feed and imported breeding stock.[239] The production capacity of the Zambian commercial sector in 2010 was estimated at 30 million broiler birds annually and 6 million eggs monthly.[240] Production is nowhere near the levels found in Southeast Asia. Furthermore, the agricultural ministry was oriented to focus on cattle and cattle diseases and not poultry and poultry problems.

External partners had a disproportionate role in influencing the pandemic preparedness policy process in Zambia. International finance, evidence and prescriptions provided a preconceived view of how pandemic preparedness should be pursued over what should have been a response based on a contextualized understanding of Zambia's policy structure, priorities, and material needs. The result was a one-size-fits-all policy that reflected global narratives that were at odds with Zambia's needs. In retrospect, the confluence of interests surrounding pandemic preparedness and economic development in Zambia presented unique challenges which required careful weighing in the financing and development of the country's avian and pandemic influenza prevention and control policy. Even at the stage where it became evident that H5N1 was unlikely to affect Zambia, international influences continued to emphasize avian influenza as a poultry problem and immi-

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[236]Mwacalimba (2012).

[237]*Id.*

[238]CSO (2004).

[239]DVLD (2009).

[240]Munang'andu et al. (2012).

nent threat, pushing agriculture to the fore and inadvertently underplaying what the issue was truly about: the pandemic concern.

42.5 Policy Issues for Food Policy and Risk Management

Our case studies presented two very different food safety risks. In the case of bovine tuberculosis, the issues highlighted a problem obscured by bigger health concerns, i.e. HIV/AIDS and human tuberculosis. The second case was that of an indeterminate risk of incursion of a disease alien to Zambia. Both presented interesting cases for food safety. The BTB case study presented a twofold risk to communities living in and around the livestock interface. First, there is a public health risk from the consumption of uninspected meat from lechwe, a wildlife species known to be a maintenance host for BTB, and second, there is the major risk from consumption of unpasteurized milk derived from tuberculosis positive herds. Milk, as previously stated, is known to be the primary means of zoonotic conveyance to humans. Of course there are other risks of acquiring BTB in this area, including aerosols from cattle with active tuberculosis lesions in their lungs, during the evisceration of infected cattle or lechwe carcasses and during the consumption of undercooked meat contaminated with *Mycobacterium bovis*. However, the two risks highlighted, and the related food processing and handling practices of the area are pertinent concerns for food safety and zoonotic risk management.

Because lechwe meat provides communities with a supplementary source of protein, lechwe that are culled for consumption within wildlife-livestock communities actually bolster local food security. This service, however, is perhaps being provided at the expense of public health. The provision of meat inspection services would help address this concern, but requires a concerted response by local health, wildlife and veterinary officials. Although meat inspection is not very sensitive and up to 60 % of discrete tuberculosis lesions may go undetected,[241] it is still necessary to mitigate the food safety risks to public health in rural livestock keeping communities such as those found in Zambia's wildlife-livestock interface. The difficulty in controlling the condition in lechwe means that the disease is unlikely to be eliminated in cattle. Food hygiene thus seems to be the primary prevention mechanism available for food governance stakeholders in the area. A long term solution would require exploring control mechanisms in the lechwe population, in addition to control of the disease in cattle.[242]

On the other hand, avian influenza presents a food safety issue that occupies a different level of importance, particularly for the international donor community, when compared to BTB. An important risk question that was not asked in rolling out the avian and pandemic influenza response in Zambia was how the country was

[241] FSAI Scientific Committee (2003).

[242] Mwacalimba et al. (2013).

linked to the global poultry industry. The focus of control instead was on the Zambia's traditional and backyard production systems, a response that addressed a risk scenario mirroring the Southeast Asian H5N1 experience where backyard production was strongly implicated in the maintenance and spread of H5N1. A few key elements where missing from Zambia, the mixed farming systems, use of wet markets and duck production.[243]

Fortunately, an outbreak of zoonotic avian influenza H5N1 never occurred in Zambia. The abatement of the threat, however, served to highlight some significant policy conflicts. Poultry and poultry production were low priorities for the Zambian Agricultural Ministry, whose veterinary department had a long list of diseases of national economic importance to tackle. The man-hours spent in pursuit of the elusive H5N1 were thus viewed as wasteful. In short the donor-driven response was not properly aligned with local economic realities.[244]

These two case studies demonstrate the complexity of issues surrounding food governance. In the case of bovine tuberculosis, there is an apparent lack of understanding for the need for its control in rural populations, despite the myriad studies demonstrating the risk to humans living in contact with infected wildlife and livestock. Some of the reasons, presumably, are based on larger health problems (human tuberculosis and HIV/AIDS), an absence of veterinary support, and a wildlife management system that is incognizant of the risks to public health. In the case of H5N1, there was no real local risk, but international interest and finance pushed its importance up the government agenda. Outside Egypt and Nigeria, the African countries that had been most impacted by H5N1, other countries in the region responded to the avian and pandemic influenza more or less because of international finance. In areas where H5N1 was a problem, there were notable food security repercussions. For example, in Nigeria, a ban in poultry and poultry product movement resulted in those regions with low poultry production unable to obtain poultry and poultry meat from the high poultry producing areas. The impact was the reduced availability of the cheapest and commonest source of protein for low-income consumers.[245]

42.6 Key Learning Points for Public Health and Food Policy

This chapter sought to describe and explain the confluence of complex issues surrounding the issue of animal health, public health and food safety governance in the African region. The background sections served to demonstrate that politics is rife around food governance and food law in the African region. Using a risk-

[243]Mwacalimba (2012).

[244]Mwacalimba and Green (2014).

[245]Muma et al. (2014).

based epidemiological model, the chapter highlighted the various problems African countries face in addressing food safety concerns, including resource constraints, legislative overlap and redundancy, donor dependency, trade rule complexity, different perceptions on livestock use, problem overload and globalization.

Because food-borne diseases and food safety are important concerns in the African region, there remains an urgent need to understand both the public health and economic impact of food-borne diseases on the continent in general and in its various countries in particular. This knowledge, however, is not a guarantee for the adequate address of food safety on national governmental agendas. It must be understood that food governance policy coherence is not a state, but a process. It is a bargained 'collective' construct, requiring a level of oversight, coordination and consensus among actors for whom coherence is relevant.[246] Therefore, considerable advocacy and policy entrepreneurship is required to garner the necessary support for food safety reform both in the African region and with the international donor community. Furthermore, it is difficult to develop a coordinated and sustainable approach to the holistic management of food safety in the African region, especially when the impact of food safety on public health and the general economy have not been adequately assessed. Therefore, while important, getting the various stakeholder institutions to understand the public health benefits of coordinated and improved food safety mechanisms remains a fundamental challenge. This is because, as alluded to earlier, modern polity is fragmented as a matter of necessity. Viewing government as a unitary body that must generate knowledge on the economic and public health impacts of food safety and develop coherent national and international food safety policies in consultation with all stakeholders along the food supply chain is difficult.

Fundamentally, a flexible structuring of food safety risk in ways that is stakeholder inclusive is what is required. It is also important to include local ecological, biological and policy considerations. A clear picture of key stakeholders needs to be developed for effective food-borne disease risk management. This could include wide stakeholder consultation in understanding food safety risks and their assessment.[247] In the case of food safety governance in the African region, there is a need to have a multi-actor view of the food supply chain, and to develop context and time specific definitions of food safety problems that would help inform food safety agendas for both national governments and the global public health community.

The Bovine Spongiform Encephalopathy (BSE) crisis in the United Kingdom provides interesting lessons for understanding the governance needs of food-borne disease risk management, particularly as it relates to zoonoses.[248] In the context of the BSE/Creutzfeldt-Jakob Disease crisis in Europe, it was found useful to assess

[246] Ashoff (2005); Blouin (2007), pp. 169–173.

[247] Stirling and Scoones (2009), http://www.ecologyandsociety.org/vol14/iss2/art14/.

[248] See Dora (2006).

public perceptions through the lens of lay epidemiology[249] where the understanding of risk problems mirrored expert knowledge.[250] For zoonosis control, such a conceptualization of risk can be extended to accommodate multiple decision-makers along the food supply chain. That is, each decision-making body, with its institutional norms and ideas, can contribute their expertise and understanding of food-borne disease risk and understanding specific to the role they play along the food chain. Of course, this requires a deliberative approach emphasizing dialogue, particularly in defining the problems and analyzing and evaluating food safety risk issues.

42.7 Conclusion

In conclusion this chapter has hinted at the fact that defining food safety risks and, indeed the process of problem identification, could be developed by considering multiple contextual issues and stakeholders along the food supply chain. It is also important to keep in mind what they perceive the risks to be, and how their definitions fit into the broad picture of food safety in general. Certainly, the application and utility of the disease prevention framework presented in the conceptual section of this paper would be greatly advanced. However, because disease control is highly politicized, a more inclusive approach is required to use evidence to support responses to global disease concerns aligned with local priorities and realities.[251] As in the case of general disease control, food safety governance requires the right questions to be raised to foster the socio-political and economic change that the international community expects from the African region.[252] As one study argues,[253] the process of instituting change cannot remain the “purview of the global North, especially when the questions asked, and the responses advocated, favor a Northern perspective of globalized risk over the ‘real’ needs of the global South.” Context will always matter and therefore, local ecological, biological and policy considerations should be given primacy. In conclusion, food safety governance regulatory processes should take into consideration local realities, local food supply chains and local food safety threats to ensure appropriateness and sustainability of any and all disease control measures instituted.

[249] This describes the processes through which health risks are understood and interpreted by laypeople. Allmark and Tod (2006).

[250] Dowler et al. (2006).

[251] Mwacalimba (2012).

[252] Colvin (2011), pp. 253–256.

[253] Mwacalimba (2012).

References

Alexander DJ (2007) An overview of the epidemiology of avian influenza. Vaccine 25:5637–5644
ALive (2006) Avian influenza prevention and control and human influenza pandemic preparedness in Africa: assessment of financial needs and gaps. In: Fourth international conference on avian influenza, Bamako, Mali, Dec 2006
Allmark P, Tod A (2006) How should public health professionals engage with lay epidemiology? J Med Ethics 32(8):460–463. doi:10.1136/jme.2005.014035
Ameni G, Bonnet P, Tibbo M (2003) A cross-sectional study if bovine tuberculosis in selected dairy farms in Ethiopia. Int J Appl Res Vet Med 1(4)
American Veterinary Medical Association (2008) One health: a new professional imperative, Final Report of the One Health Initiative Task Force (July 15, 2008)
Aranaz A et al (2004) Bovine tuberculosis (*mycobacterium bovis*) in wildlife in Spain. J Clin Microbiol 42(6):2602–2608
Ashoff G (2005) Enhancing policy coherence for development: justification, recognition and approaches to achievement. German Development Institute, Bonn
Ayele WY, Neill SD, Zinsstag J, Pavlik I (2004) Bovine tuberculosis: an old disease but a new threat to Africa. Int J Tuberc Lung Dis 8(8):924–937
Barling D, Lang T (2004) Trading on health: cross-continental production and consumption tensions and the governance of international food standards
Bartlett JG (2006) Planning for avian influenza. Ann Intern Med 145:141–144
Beigel JH, Farrar J, Han AM, Hayden FG, Hyer R, de Jong MD, Lochindarat S, Nguyen TK, Nguyen TH, Tran TH, Nicoll A, Touch S, Yuen KY (2005) Avian influenza A (H5N1) infection in humans. N Engl J Med 353:1374–1385
Blouin C (2007) Trade policy and health: from conflicting interests to policy coherence. Bull World Health Organ 85:169–173
Brosch R, Gordon SV, Marmiesse M, Brodin P, Buchrieser C, Eiglmeier K, Garnier T, Gutierrez C, Hewinson G, Kremer K, Parsons LM, Pym AS, Samper S, van Soolingen D, Cole ST (2002) A new evolutionary scenario for the Mycobacterium tuberculosis complex. Proc Natl Acad Sci U S A 99(6):3684–3689, Epub 2002 Mar 12
Bruckner GK (2009) The role of the World Organisation for Animal Health (OIE) to facilitate the international trade in animals and animal products. Onderstepoort J Vet Res 76:141–146
Burgos S, Otte J (2008) Animal health in the 21st century: challenges and opportunities: Pro-Poor Livestock Policy Initiative, Research report 09-06
Buse K, Mays N, Walt G (2005) Making health policy. Open University Press
Buzby JC, Roberts T (2009) The economics of enteric infections: human foodborne disease costs. Gastroenterology 136(6):1851–1862. doi:10.1053/j.gastro.2009.01.074
Capua I, Alexander DJ (2004) Avian influenza: recent developments. Avian Pathol 33:393–404
Cattoli G, Monne I, Fusaro A, Joannis TM, Lombin LH, Aly MM, Arafa AS, Sturm-Ramirez KM, Couacy-Hymann E, Awuni JA, Batawui KB, Awoume KA, Aplogan GL, Sow A, Ngangnou AC, El Nasri Hamza IM, Gamatie D, Dauphin G, Domenech JM, Capua I (2009) Highly pathogenic avian influenza virus subtype H5N1 in Africa: a comprehensive phylogenetic analysis and molecular characterization of isolates. PLoS One 4, e4842
Chabwela HNW, Mumba W (1998) Integrating water conservation and population strategies on the Kafue Flats. In: de Sherbinin A, Dompka V (eds) Water and population dynamics. American Association for the Advancement of Science, Washington
Chang HJ (2003) Kicking away the ladder: the "real" history of free trade: FPIF Special Report "Globalization and the Myth of Free Trade", April 18, 2003, The New School University in New York City
Chen H, Smith GJ, Zhang SY, Qin K, Wang J, Li KS, Webster RG, Peiris JS, Guan Y (2005) Avian flu: H5N1 virus outbreak in migratory waterfowl. Nature 436:191–192
Colston MJ (2001) Mycobacterial infection from the cellular point of view. Acta Cient Venez 52 (Suppl 1):13–15

Colvin CJ (2011) Think locally, act globally: developing a critical public health in the global South. Crit Public Health 21(3):253–256

Conly JM, Johnston BL (2004) Avian influenza - The next pandemic? Can J Infect Dis Med Microbiol 15:252–254

Cook AJC, Tuchili LM, Buve A, Foster SD, Godfrey-Faussett P, Panday GS, McAdam KPWJ (1996) Human and bovine tuberculosis in the Monze district of Zambia-a cross-sectional study. Br Vet J 152:37–46

Cosivi O, Grange JM, Daborn CJ, Raviglione MC, Fujikura T, Cousins D, Rabinson RA, Huchzermeyer HFAK, de Kantor I, Meslin FX (1998) Zoonotic tuberculosis due to Mycobacterium bovis in developing countries. Emerg Infect Dis 4(1):59–70

CSO (2004) Living conditions monitoring survey. Central Statistics Office, Lusaka

Dewaal CS, Robert N, Witmer J, Tian XA (2010) A comparison of the burden of foodborne and waterborne diseases in three world regions, 2008. Food Protect Trends 30(8):483–490

Domenech J, Lubroth J, Eddi C, Martin V, Roger F (2006) Regional and international approaches on prevention and control of animal transboundary and emerging diseases. Ann N Y Acad Sci 1081:90–107

Dora C (2006) Seeking lessons from BSE/CJD for communication strategies on health and risk: In: Dora C (ed) Health, hazards and public debate: lessons from risk communication from the BSE/CJD saga. WHO

Douglas M, Wildavsky A (1982) Risk and culture. University of California Press, Berkeley

Dowler E, Green J, Bauer M, Gasperoni G (2006) Assessing public perception: issues and methods: In: Dora C (ed) Health, hazards and public debate: Lessons from risk communication from the BSE/CJD saga. WHO

DVLD (2009) Zambia poultry sector study: risk mapping activity – ILRI EDRS-AIA project: early detection, reporting and surveillance –Avian Influenza in Africa. C/09/079:MK04 STA USA064 102

Elbe S (2010) Haggling over viruses: the downside risks of securitizing infectious disease. Health Policy Plan 25:476–485

Eurosurveillance (2006) Highly pathogenic avian influenza A/H5N1 – update and overview of 2006: Eurosurveillance weekly release. Euro Surveill 11(12):E061221.1

FAO (2004) Poultry production sectors: Food and Agriculture Organization of the United Nations. Available at http://www.fao.org/docs/eims/upload//224897/factsheet_productionsectors_en.pdf

FAO (2005) Analysis of the food safety situation in Zambia. In: FAO/WHO regional conference on food safety for Africa, Harare, Zimbabwe, 3–6 October 2005

FAO (2010) Avian influenza outbreaks: Food and Agriculture Organisation of the United Nations. Available at http://www.fao.org/avianflu/en/maps.html

Fidler DP (2004a) Global outbreak of Avian Influenza A (H5N1) and international law. American Society of international law 8(1). January 25, 2004

Fidler DP (2004b) Germs, governance, and global public health in the wake of SARS. J Clin Invest 113:799–804

Fidler DP (2008) Influenza virus samples, international law, and global health diplomacy. Emerg Infect Dis 14:88–94

FSAI Scientific Committee (2003) Zoonotic tuberculosis and food safety. Zoonotic tuberculosis-Final report, Food Safety Authority of Ireland Scientific Committee, July 2003 http://www.fsai.ie/publications/other/zoonotic_tuberculosis.pdf

Garrett L, Fidler DP (2007) Sharing H5N1 viruses to stop a global influenza pandemic. PLoS Med 4, e330

Gibson AL, Hewinson G, Goodchild T, Watt B, Story A, Inwald J, Drobniewski FA (2004) Molecular epidemiology of disease due to Mycobacterium bovis in humans in the United Kingdom. J Clin Microbiol 42(1):431–434

Gilbert M, Xiao X, Pfeiffer DU, Epprecht M, Boles S, Czarnecki C, Chaitaweesub P, Kalpravidh W, Minh PQ, Otte MJ, Martin V, Slingenbergh J (2008) Mapping H5N1 highly pathogenic avian influenza risk in Southeast Asia. Proc Natl Acad Sci U S A 105:4769–4774

GRAIN (2006) The top-down global response to bird-flu: against the GRAIN. http://www.grain.org/articles/?id=12
GRAIN (2007) Bird flu: a bonanza for 'Big Chicken.' Against the Grain. http://www.grain.org/articles/?id=22
Grange JM (2001) Mycobacterium bovis infection in human beings. Tuberculosis 81(1/2):71–77
Green A (1999) An introduction to health planning in developing countries, 2nd edn. Oxford Medical Publications/Oxford University Press, Oxford
Green J (2012) 'One health, one medicine' and critical public health. Crit Public Health 22:377–381
Greger M (2007) The human/animal interface: emergence and resurgence of zoonotic infectious diseases. Crit Rev Microbiol 33:243–299
Grootenhuis JG, Olubayo RO (1993) Disease research in the wildlife-livestock interface in Kenya. Vet Q 15(2):55–59
GRZ (2006) National task force on avian influenza: operational guidelines 2006. Lusaka Government of Zambia
Hall DC, Ehui S, Delgado C (2004) The livestock revolution, food safety, and small-scale farmers: why they matter to us all. J Agric Environ Ethics 17:425–444
Hampson AW (1997) Surveillance for pandemic influenza. J Infect Dis 176(Suppl 1):S8–S13
Hancox M (2000) Letter to the editors: cattle tuberculosis schemes: control or eradication? The society for applied microbiology. Lett Appl Microbiol 31:87–93
Hollenbeck JE (2005) An avian connection as a catalyst to the 1918-1919 influenza pandemic. Int J Med Sci 2:87–90
Horlick-Jones T (1998) Social theory and the politics of risk. J Conting Crisis Manag 6:64–67
Horowitz L (2005) The Avian flu fright: politically timed for global "Iatrogenocide." Global Research, October 12, 2005
Hubálek Z (2003) Emerging human infectious diseases: anthroponoses, zoonoses, and sapronoses. Emerg Infect Dis 9(3):403–404. doi:10.3201/eid0903.020208
Hueston WD (2003) Science, politics and animal health policy: epidemiology in action. Prev Vet Med 60:3–12
Jeffery RCV, Malambo CH and Nefdt R (1991) Wild mammal surveys of the Kafue flats. A Report to the Director, National Parks andWildlife Service, Chilanga, Zambia
Käferstein FK, Motarjemi Y, Bettcher DW (1997) Foodborne disease control: a transnational challenge. Emerg Infect Dis 3:503–510
Kahn LH, Kaplan B, Steele JH (2007) Confronting zoonoses through closer collaboration between medicine and veterinary medicine (as 'one medicine'). Vet Ital 43:5–19
Karesh WB, Cook RA, Bennett EL, Newcomb J (2005) Wildlife trade and global disease emergence. Emerg Infect Dis 11:1000–1002
Kasemsuwan S, Poolkhet C, Patanasatienkul T, Buameetoop N, Watanakul M, Chanachai K, Wongsathapornchai K, Métras R, Marcé C, Prakarnkamanant A, Otte J, Pfeiffer D (2009) Qualitative risk assessment of the risk of introduction and transmission of H5N1 HPAI virus for 1-km buffer zones surrounding compartmentalised poultry farms in Thailand Mekong Team Working Paper No. 7
Kazwala RR, Daborn CJ, Sharp JM, Kambarage DM, Jiwa SFH, Mbembati NA (2001) Isolation of Mycobacterium bovis from human cases of cervical adenitis in Tanzania: a cause for concern? Int J Tuberc Lung Dis 5(1):87–91
Kells HR, Lear SA (1959) Thermal death time curve of Mycobacterium tuberculosis var. bovis in artificially infected milk. Paper of the journal series, New Jersey agricultural experiment station, Rutgers, the State University, Department of Dairy Science, New Brunswick, New Jersey, vol 8
Kilpatrick AM, Chmura AA, Gibbons DW, Fleischer RC, Marra PP, Daszak P (2006) Predicting the global spread of H5N1 avian influenza. Proc Natl Acad Sci U S A 103:19368–19373
Kimball AM (2006) Risky trade: infectious diseases in the era of global trade. Ashgate Publishing, London

Kimball AM, Arima Y, Hodges JR (2005) Trade related infections: farther, faster, quieter. Glob Health 1:3
Kingdon JW (2003) Agendas, alternatives and public policies, 2nd edn. Addison-Wesley Educational Publishers Inc, New York
Kock RA (2003) What is this infamous "wildlife/livestock disease v. interface?" A review of current knowledge for the African Continent. In: Osofsky SA (ed) Conservation and development interventions at the wildlife/livestock interface implications for wildlife, livestock and human health
Kock ND, Kampamba G, Mukaratirwa S, Du Toit J (2002) Disease investigation into free-ranging Kafue lechwe (Kobus leche kafuensis) on the Kafue Flats in Zambia. Vet Rec 151:482–484
Krauss H, Weber A, Appel M, Enders B, Isenberg HD, Schiefer HG, Slenczka W, von Graevenitz A, Zahner H (2003) Zoonoses: infectious diseases transmissible from animals to humans, 3rd edn. ASM press, Washington
Kruk ME (2008) Emergency preparedness and public health systems lessons for developing countries. Am J Prev Med 34:529–534
Lee K, Koivusalo M (2005) Trade and health: is the health community ready for action? PLoS Med 2, e8
Lee K, Fustukian S, Buse K (2002) An introduction to global health policy. In: Lee K, Buse K, Fustukian S (eds) Health policy in a globalising world. Cambridge University Press, Cambridge
MacDonald R, Horton R (2009) Trade and health: time for the health sector to get involved. Lancet 373:273–274
Menzies FD, Neill SD (2000) Cattle-to-cattle transmission of bovine tuberculosis. Vet J 160:92–106. Harcourt Publishers Ltd
Mfinanga SG, Mørkve O, Kazwala RR, Cleaveland S, Sharp JM, Shirima G, Nilsen R (2003a) The role of livestock keeping in tuberculosis trends in Arusha, Tanzania. Int J Tuberc Lung Dis 7 (7):695–704
Mfinanga SG, Mørkve O, Kazwala RR, Cleaveland S, Sharp JM, Shirima G, Nilsen R (2003b) Tribal differences in perception of tuberculosis: a possible role in tuberculosis control in Arusha, Tanzania. Int J Tuberc Lung Dis 7(10):933–941
Moda G, Daborn CJ, Grange JM, Cosivi O (1996) The zoonotic importance of Mycobacterium bovis. Tuber Lung Dis 77:103–108
Monto AS, Comanor L, Shay DK, Thompson WW (2006) Epidemiology of pandemic influenza: use of surveillance and modeling for pandemic preparedness. J Infect Dis 194(Suppl 2):S92–S97
Morens DM, Fauci AS (2007) The 1918 influenza pandemic: insights for the 21st century. J Infect Dis 195:1018–1028
Mudenda D (2005) Zambia's trade situation: implications for debt and poverty reduction. A report on Zambia's trade situation by the Jesuit Centre for Theological Reflection
Muma JB, Mwacalimba KK, Munang'andu HM, Matope G, Jenkins A, Siamudaala V, Mweene AS, Marcotty T (2014) The contribution of veterinary medicine to public health and poverty reduction in developing countries. Vet Ital 50:117–129
Mumba M (2004) Biodiversity challenges for invaded wetland ecosystems in Africa: the case of the Kafue Flats floodplain system in southern Zambia. In: Proceedings of a global synthesis workshop on 'Biodiversity loss and species extinctions: managing risk in a changing world' Sub theme: invasive alien species-coping with aliens
Mumba C, Samui KL, Pandey GS, Hang'ombe BM, Simuunza M, Tembo G, Muliokela SW (2011) Economic analysis of the viability of smallholder dairy farming in Zambia. Livest Res Rural Dev 23:137
Munang'andu HM, Kabilika SH, Chibomba O, Munyeme M, Muuka GM (2012) Bacteria isolations from broiler and layer chicks in Zambia. J Pathog 2012, 520564
Munyeme M, Munang'andu HM (2011) A review of bovine tuberculosis in the kafue basin ecosystem. Vet Med Int 2011:918743

Munyeme M, Muma JB, Samui KL, Skjerve E, Nambota AM, Phiri IGK, Rigouts L, Tryland M (2008) Prevalence of bovine tuberculosis and animal level risk factors for indigenous cattle under different grazing strategies in the livestock/wildlife interface areas of Zambia. Trop Anim Health Prod 41:345–352

Munyeme M, Muma JB, Siamudaala VM, Skjerve E, Munang'andu HM, Tryland M (2010a) Tuberculosis in Kafue lechwe antelopes (*Kobus leche Kafuensis*) of the Kafue Basin in Zambia. Prev Vet Med 95(3–4):305–308

Munyeme M, Muma JB, Munang'andu HM, Kankya C, Skjerve E, Tryland M (2010b) Cattle owners' awareness of bovine tuberculosis in high and low prevalence settings of the wildlife-livestock interface areas in Zambia. BMC Vet Res 6:21

Mwacalimba KK (2012) Globalised disease control and response distortion: a case study of avian influenza pandemic preparedness in Zambia. Crit Public Health 22:391–405

Mwacalimba K (2013) Pandemic preparedness and multi-sectoral zoonosis risk management: implications for risk assessment of avian influenza in Zambian trade, health and agriculture. LAP LAMBERT Academic Publishing

Mwacalimba KK, Green J (2014) 'One health' and development priorities in resource constrained countries: policy lessons from avian and pandemic influenza preparedness in Zambia. Health Policy Plan 30:215–222. doi:10.1093/heapol/czu001

Mwacalimba KK, Mumba C, Munyeme M (2013) Cost benefit analysis of tuberculosis control in wildlife–livestock interface areas of Southern Zambia. Prev Vet Med 110(2):274–279

Navarro V (1998) Comment: whose globalization? Am J Public Health 88:742–743

Ndulo M (2006) Zambia and the multilateral trading system: the impact of WTO agreements, negotiations and implementation. United Nations Conference on Trade and Development. UNCTAD/DITC/TNCD/2005/16

Neill S, Bryson D, Pollock J (2001) Pathogenesis of tuberculosis in cattle. Tuberculosis 81:79–86

Nicoll A (2005) Avian and pandemic influenza--five questions for 2006. Euro Surveill 10:210–211

Niemann S, Richter E, Rüsch-Gerdes S (2000) Differentiation among members of the Mycobacterium tuberculosis complex by molecular and biochemical features: evidence for two pyrazinamide-susceptible subtypes of M. bovis. J Clin Microbiol 38:152–157

Normile D (2006) Avian influenza. Evidence points to migratory birds in H5N1 spread. Science 311:1225

O'Reilly LM, Daborn CJ (1995) The epidemiology of Mycobacterium bovis infections in animals and man: a review. Tuber Lung Dis 76(Suppl 1):1–46

OIE (2004) Handbook on import risk analysis for animals and animal products. Vol 1 Introduction and qualitative risk analysis. World organisation for animal health, Paris, pp 1–46

OIE (2010) Manual of diagnostic tests and vaccines for terrestrial animals

Ong A, Kindhauser M, Smith I, Chan M (2008) A global perspective on avian influenza. Ann Acad Med Singapore 37:477–481

Omamo SW, Farrington J (2004) Policy research and African agriculture: time for a dose of reality? ODI. Natural resource perspectives no. 90

Ortu G, Mounier-Jack S, Coker R (2007) Pandemic influenza preparedness in the African continent: analysis of national strategic plans. London School of Hygiene and Tropical Medicine

Ortu G, Mounier-Jack S, Coker R (2008) Pandemic influenza preparedness in Africa is a profound challenge for an already distressed region: analysis of national preparedness plans. Health Policy Plan 23:161–169

Osterholm MT (2005) Preparing for the next pandemic. N Engl J Med 352:1839–1842

Pandey GS (2004) Tuberculosis in the Kafue lechwe (Kobus leche Kafuensis) and its public health significance particularly game meat utilization in Zambia. In: Proceedings at the Commonwealth Veterinary Association/Veterinary Association of Zambia joint Regional Conference for Eastern, Central and Southern Africa. Special Issue, pp 17–20

Paul M, Tavornpanich S, Abrial D, Gasqui P, Charras-Garrido M, Thanapongtharm W, Xiao X, Gilbert M, Roger F, Ducrot C (2010) Anthropogenic factors and the risk of highly pathogenic avian influenza H5N1: prospects from a spatial-based model. Vet Res 41:28

Phiri AM et al (2011) Helminth parasites of the Kafue lechwe antelope (Kobus leche kafuensis): a potential source of infection to domestic animals in the Kafue wetlands of Zambia. J Helminthol 85(1):20–27. doi:10.1017/S0022149X10000192, Epub 2010 Apr 14

Pitrelli N, Sturloni G (2007) Infectious diseases and governance of global risks through public communication and participation. Ann Ist Super Sanita 43:336–343

Rabinowitz PM, Odofin L, Dein FJ (2008) From "us vs. them" to "shared risk": can animals help link environmental factors to human health? Ecohealth 5:224–229

Rweyemamu MM, Astudillo VM (2002) Global perspective for foot and mouth disease control. Rev Sci Tech 21:765–773

Scoones I (2010) The international response to avian influenza: science, policy and politics. In: Scoones I (ed) Avian influenza: science, policy and politics, Pathways to sustainability series. Earthscan, London

Scoones I, Forster P (2008a) HPAI and International policy processes – a scoping study: Research Report. Controlling Avian Flu and Protecting livelihoods, A DFID-funded collaborative research project. STEPS Centre

Scoones I, Forster P (2008b) The international response to highly pathogenic avian influenza: science, policy and politics steps centre. http://www.steps-centre.org/PDFs/Avian%20flu%20final%20w%20cover.pdf

Shortridge KF, Zhou NN, Guan Y, Gao P, Ito T, Kawaoka Y, Kodihalli S, Krauss S, Markwell D, Murti KG, Norwood M, Senne D, Sims L, Takada A, Webster RG (1998) Characterization of avian H5N1 influenza viruses from poultry in Hong Kong. Virology 252:331–342

Siamudaala VM (2004) The role of wildlife in poverty alleviation. Zambian J Vet Sci (Special Issue on the Proceedings of the CVA/VAZ Joint Regional Conference for Eastern, Central and Southern Africa):48–52

Siamudaala VM, Muma JB, Munang'andu HM, Mulumba M (2003) Disease challenges on the conservation and utilisation of the Kafue lechwe (Kobus leche Kafuensis) in Zambia. In: Conservation and development innovations at the wildlife/livestock interface: implications for wildlife, livestock and human health

Simasiku P, Simwanza H, Tembo G, Bandyopadhyay S, Pavy J (2008) The impact of wildlife management policies on communities and conservation in game management areas in Zambia. Natural Resources Consultative Forum, Zambia

Sims L, Narrod C (2008) Understanding avian influenza – a review of the emergence, spread, control, prevention and effects of Asian-lineage H5N1 highly pathogenic viruses: United Nations Food and Agriculture Organization (FAO). www.fao.org/avianflu

Sims LD, Domenech J, Benigno C, Kahn S, Kamata A, Lubroth J, Martin V, Roeder P (2005) Origin and evolution of highly pathogenic H5N1 avian influenza in Asia. Vet Rec 157:159–164

Slingenbergh J (2004) Environmental, climatic risk factors: abstracts of keynote speeches. Report of the WHO/FAO/OIE joint consultation on emerging zoonotic diseases, 3–5 May 2004

Smith VH, Sumner DA, Rosson CP (2002) Bilateral and multilateral trade agreements. In: Outlaw JL, Edward G (eds) The 2002 farm bill: policy options and consequences, Smith Publication No. 2001–01. Farm Foundation, Oak Brook, IL, September 2001

Soares Magalhaes RJ, Ortiz-Pelaez A, Thi KL, Dinh QH, Otte J, Pfeiffer DU (2010) Associations between attributes of live poultry trade and HPAI H5N1 outbreaks: a descriptive and network analysis study in northern Vietnam. BMC Vet Res 6:10

Stärk KD, Regula G, Hernandez J, Knopf L, Fuchs K, Morris RS, Davies P (2006) Concepts for risk-based surveillance in the field of veterinary medicine and veterinary public health: review of current approaches. BMC Health Serv Res 6:20

Stiglitz JE (2009) Trade agreements and health in developing countries. Lancet 373:363–365

Stirling AC, Scoones I (2009) From risk assessment to knowledge mapping: science, precaution and participation in disease ecology. Ecol Soc 14. http://www.ecologyandsociety.org/vol14/iss2/art14/
Tambi E, Bessin R (2006) The WTO agreement on agriculture: effects on livestock production and trade in Africa African Union/Interafrican Bureau for Animal Resources Pan African programme for the Control of Epizootics European Commission, 16 January 2006
Tamiru F, Hailemariam M, Ter W (2013) Preliminary study on prevalence of bovine tuberculosis in cattle owned by tuberculosis positive and negative farmers and assessment of zoonotic awareness in Ambo and Toke Kutaye districts, Ethiopia. J Vet Med Anim Health 5 (10):288–295
Thiermann AB (2005) Globalization, international trade and animal health: the new roles of OIE. Prev Vet Med 67:101–108
Thomson GR, Tambi EN, Hargreaves SK, Leyland TJ, Catley AP, van't Klooster GG, Penrith ML (2004) International trade in livestock and livestock products: the need for a commodity-based approach. Vet Rec 155:429–433
UN (2010) Hanoi declaration at the international ministerial conference: "Animal and pandemic influenza: the way forward". Hanoi, Vietnam, 19–21 April 2010. IMCAPI Hanoi 2010: http://www.un-influenza.org/node/4040
UNGASS (2012) Monitoring the declaration of commitment on HIV and AIDS and the universal access. Zambia Country report 2012: UNGASS 2012 Country reports, UNAIDS
Unger F, Münstermann S, Goumou A, Apia CN, Konte M (2003) Risk associated with Mycobacterium bovis infections detected in selected study herds and slaughter cattle in 4 countries of West Africa. Animal Health Working Paper 1. ITC (International Trypanotolerance Centre), Banjul, The Gambia, p 25.
UNSIC (2006) Avian and human influenza: UN system contributions and requirements. A strategic approach: Office of the United Nations System Influenza Coordinator. UNSIC/Strategy/Final
UNSIC (2006) Pandemic planning and preparedness guidelines for the United Nations system
UNSIC and World Bank (2008) Responses to avian influenza and state of pandemic readiness. Fourth Global Progress Report
Upton M, Otte J (2004) The impact of trade agreements on livestock producers pro-poor livestock policy initiative. Research Report. RR Nr. 04-01
Vallat B, Pastoret P-P (2009) The role and mandate of the World Organisation for Animal Health in veterinary education. Rev Sci Tech 28(2):503–510
van den Berg T (2009) The role of the legal and illegal trade of live birds and avian products in the spread of avian influenza. Rev Sci Tech 28:93–111
Van Kerkhove MD, Vong S, Guitian J, Holl D, Mangtani P, San S, Ghani AC (2009) Poultry movement networks in Cambodia: implications for surveillance and control of highly pathogenic avian influenza (HPAI/H5N1). Vaccine 27:6345–6352
Walt G (1994) Health policy: an introduction to process and power. Zed Books, London
Walt G, Gilson L (1994) Reforming the health sector in developing countries: the central role of policy analysis. Health Policy Plan 9:353–370
Weber TP, Stilianakis NI (2007) Ecologic immunology of avian influenza (H5N1) in migratory birds. Emerg Infect Dis 13:1139–1143
Webster RG (1997) Predictions for future human influenza pandemics. J Infect Dis 176(Suppl 1):S14–S19
Webster RG, Govorkova EA (2006) H5N1 influenza — continuing evolution and spread. N Engl J Med 355:2174–2177
Webster R, Hulse D (2005) Controlling avian flu at the source. Nature 435:415–416
Webster RG, Guan Y, Peiris M, Walker D, Krauss S, Zhou NN, Govorkova EA, Ellis TM, Dyrting KC, Sit T, Perez DR, Shortridge KF (2002) Characterization of H5N1 influenza viruses that continue to circulate in geese in southeastern China. J Virol 76:118–126

WHO (2004) Press release: unprecedented spread of avian influenza requires broad collaboration-FAO/OIE/WHO call for international assistance: January 27, 2004, at http://www.who.int/mediacentre/releases/2004/pr7/en/
WHO (2005a) Avian influenza: assessing the pandemic threat: http://www.who.int/csr/disease/influenza/H5N1-9reduit.pdf
WHO (2005b) WHO global influenza preparedness plan: the role of WHO and recommendations for national measures before and during pandemics: World Health Organization, WHO/CDS/CSR/GIP/2005.5
WHO (2005c) Avian influenza and the pandemic threat in Africa: risk assessment for Africa World Health Organization. http://www.who.int/csr/disease/avian_influenza/riskassessmentAfrica/en/index.html. Accessed 10 June 2010
WHO (2006) Avian influenza frequently asked questions: WHO. Available at: http://www.who.int/csr/disease/avian_influenza/avian_faqs/en/index.html
WHO (2010) Cumulative number of confirmed human cases of avian influenza A/(H5N1) Reported to WHO: WHO. Available at: http://www.who.int/csr/disease/avian_influenza/country/cases_table_2010_11_19/en/index.html
WHO/DFID-AHP (2005) Meeting on control of zoonotic diseases: a route to poverty alleviation among livestock-keeping communities. WHO headquarters, Geneva (salle d). 20 and 21 September 2005
WHO-AFRO (2005) Avian influenza and the pandemic threat in Africa: risk assessment for Africa World Health Organization. http://www.who.int/csr/disease/avian_influenza/riskassessmentAfrica/en/index.html
WHO-AFRO (2012) Manual for integrated food-borne disease surveillance in the WHO African region. The World Health Organisation African Regional Office (WHO-AFRO)
Wilkins M (2000) Assessing the Risk of Human Health from bovine tuberculosis in Michigan. Epi Insight, Michigan Department of Community Health. DCH-0709 (Rev. 12/00)
Wilson JS, Otsuki T (2001) Global trade and food safety: winners and losers in a fragmented system. Policy Working Group Research Paper. The World Bank
Xu X, Subbarao, Cox NJ, Guo Y (1999) Genetic characterization of the pathogenic influenza A/Goose/Guangdong/1/96 (H5N1) virus: similarity of its hemagglutinin gene to those of H5N1 viruses from the 1997 outbreaks in Hong Kong. Virology 261:15–9
Yee KS, Carpenter TE, Cardona CJ (2009) Epidemiology of H5N1 avian influenza. Comp Immunol Microbiol Infect Dis 32:325–340
Yupiana Y, de Vlas SJ, Adnan NM, Richardus JH (2010) Risk factors of poultry outbreaks and human cases of H5N1 avian influenza virus infection in West Java Province, Indonesia. Int J Infect Dis 14:e800–e805
Zepeda C, Salman M, Thiermann A, Kellar J, Rojas H, Willeberg P (2005) The role of veterinary epidemiology and veterinary services in complying with the World Trade Organization SPS agreement. Prev Vet Med 67:125–140
Zinsstag J, Schelling E, Roth F, Bonfoh B, de Savigny D, Tanner M (2007) Human benefits of animal interventions for zoonosis control. Emerg Infect Dis 13:527–531
Zumla A, Malon P, Henderson J, Grange J (2000) Impact of HIV infection on tuberculosis. Postgrad Med J 76(895):259–268. doi:10.1136/pmj.76.895.259